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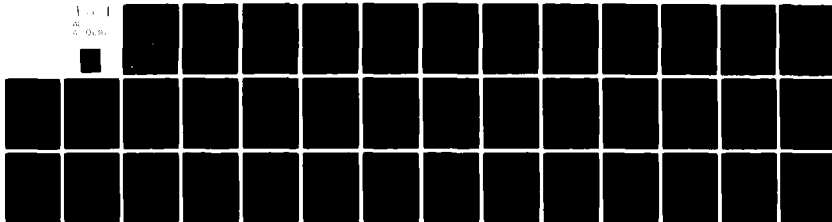
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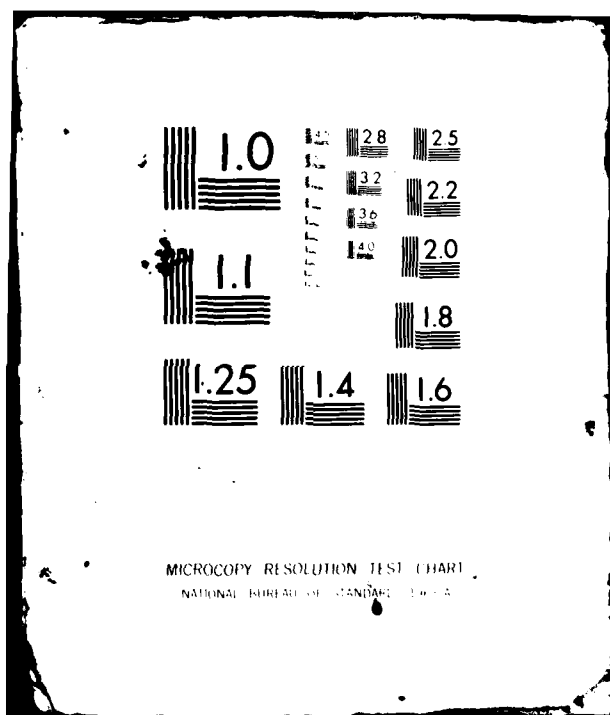
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BEHAVIORAL SCIENCES

Blood Lead Concentration and Performance	N.A. Bond, Jr.	439
Task Complexity and Team Organization	N.A. Bond, Jr.	440
Tobacco Use: Smokers, Snuffers, and Stoppers	N.A. Bond, Jr.	441

BIOLOGICAL SCIENCES

International Symposium on Recent Advances in Enteric Infections, Bruges, Belgium, 8-11 September 1981	J.C. Coolbaugh	443
--	----------------	-----

CHEMISTRY

32nd Meeting of the International Society of Electrochemistry in Dubrovnik/Cavtat, Yugoslavia: 13-20 September 1981	E. Yeager	445
---	-----------	-----

COMMUNICATIONS SCIENCES

Laboratoire D'Informatique Pour La Mecanique Et Les Sciences De L'Ingenieur (LIMSI), France	P. Fire	447
---	---------	-----

COMPUTER SCIENCES

Centralized Government Management Information System in Israel	Y.S. Wu	449
The IBM Israel Scientific Center: An Ultrasound Signal Processing Facility	Y.S. Wu	451

EARTH SCIENCES

Lightning Research in the Ivory Coast, Italy, and France	E.P. Krider	453
--	-------------	-----

MATERIAL SCIENCES

Metallurgical Research at the Royal Aircraft Establishment	P.A. Clarkin	455
Some Processing Research at Imperial College	P.A. Clarkin	457

PHYSICS

Magnet Manufacturing in Sussex	J.R. Neighbours	460
Solid State Physics in Stockholm	J.R. Neighbours	461

NEWS AND NOTES

News		463
ONR Cosponsored Conference		465
ONRL Visiting Scientist Program		466
ONRL Report Abstracts		466
Subject Index, Volume 35, 1981		468

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BEHAVIORAL SCIENCES

BLOOD LEAD CONCENTRATION AND PERFORMANCE

Several deleterious effects of high lead concentrations in the blood of children have been claimed: impaired performance on IQ and attainment tests, hyperactivity, and various behavioral problems. Some reports have aroused public concern and have led to surveys of lead levels and even to the chelation treatment of certain children. There is no doubt that massive lead exposure can damage the brain; the practical question is whether levels on the order of 20 to 40 micrograms per deciliter should be of concern, because these levels may be approached via exposure to automobile or industrial fumes. Perhaps the largest study of the effects of moderate lead levels, carried out by H.L. Needleman (Children's Hospital Medical Center, Boston, MA) in the US, was reported in 1979. He started with some 3,000 children, eliminated 700 of them, and did much of the statistical analysis on two extreme groups—those with the highest and lowest lead levels. Using tooth lead (from lost milk teeth), Needleman found substantial correlations between teacher ratings and (extreme) lead levels. But his technique of extreme-group comparisons and other methodological aspects made the study unconvincing to some investigators. The evidence was strong enough to cause concern but not to be conclusive.

In Britain last year, the Department of Health and Social Security issued the famous Lawther Working Party Report on Lead and Health. That document stated that the party "...was not able to come to clear conclusions concerning the effects of small amounts of lead on the intelligence, behavior, and performance of children." William Yule (Institute of Psychiatry, London) and Richard Lansdown (Great Ormond Street Hospital for sick children, London) have just finished a pilot study that is the first of a series of lead checks. The issue remains politically important in Britain because of the possible implications for controlling petrol exhaust and other lead sources. Present UK restrictions on leaded automotive fuels are not nearly as stringent as those in the US.

Yule and his colleagues had a sample of 166 primary school children from Greenwich, England. The blood lead levels of the children had been determined some 9 to 12 months earlier in response to an EEC directive that recommended screening

surveys (a lead works was in the vicinity). Yule's group rated each child on the WISC-R intelligence scale and also administered other standard tests of reading, spelling, and mathematics. Reading was tested individually with other performance measures being obtained in a small-group setting. The "social class" of each child was also estimated on a six-point scale. Counting six test scores (three from the WISC), age, sex, social class, and lead levels, 10 variables were recorded for each child.

In a nutshell, higher blood lead levels were associated with lower test scores. This was true even when age, sex, and social class were partialled out statistically. Upon step-wise regression analysis, lead level was usually either first or second in importance when the performance scores were used as the criterion. The proportion of criterion variance explained by lead was small, but it was consistent over most of the comparisons. (One exception to this pattern was mathematics, where relations with lead level were nonsignificant.) It is possible to make some tentative statements about the implications of lead; thus, for the Wechsler Full-scale IQs, there is an average difference of 7 IQ points between children with blood lead levels of 12 mg/100 ml and below, and those who show higher levels. At least on these data, having high lead "costs" a child a few IQ points, even though all the scores found were well below "pathological" levels.

As higher blood lead is found in children who come from families lower in the socioeconomic scale and IQ also tends to be lower in those families, the operation of social class is a troubling factor in multivariate studies. And holding things constant by partial correlation may not be fully satisfactory, though it may be the best the investigator can do. Furthermore, the lead measurement parameters themselves often are not evaluated for reliability; much more data are needed on long-term followup. Despite such difficulties, the importance of the Yule-Lansdown findings should encourage more definitive trials; in fact a contract for a much larger study has just been announced. The work can be expected to involve a large cohort in each age group, more rigorous scoring of social class, and reliability checks on all the measurements. The larger survey will be watched closely by UK public health authorities.

Nicholas A. Bond, Jr.

ONR London

TASK COMPLEXITY AND TEAM ORGANIZATION

Many "detect, plot, and track" tasks are to be found in modern vehicular operations; aircraft, harbor, and fleet control are among the obvious examples. As derived from radar or other sources, target signals appear on map-like screens, or perhaps in special lists and displays. Operators notice, tag, and monitor the signals in various ways according to the situation. There are often complex rules for ignoring and excluding targets, for handing them over to other controllers for estimating the "quality" of track data, and for intervening in the current vehicular movements. From the human factors standpoint, the most interesting situations are those wherein human and system processing loads are high. One supposes that, with so much activity, the response and recovery time constraints will be tighter, mistakes will be apt to affect more components of the system, and serious conflicts will be more likely. (Surprisingly, some of the worst air control failures, such as the Azores and Chicago airport disasters, have occurred in medium- or low-load conditions).

When teams of people are involved, variables such as team organization and communication-control arrangements can be important determinants of performance. For many medium-load control operations, the roles and structures have evolved into quite obvious patterns of behavior. In a small-city airport control tower, it may be sufficient to assign one man to ground control and one man to approach or departure control, to rotate experienced people through the positions, and to break in trainees during relatively slow periods. Though all radio transmissions are automatically recorded and a simple log of takeoffs and landings may be kept, these archival data do not have to be communicated immediately to anybody else. Even under high-load conditions, the controllers in the tower can stack up the planes and send them around the pattern again without serious inconvenience.

Military ship and plane control often occurs in a more demanding environment in which every effort is made to operate at near-maximum efficiency. And the control task may involve the communication of vehicle information among several people. For such environments it is desirable to know the best team organization for various task conditions. At the University of Aston in Birmingham, England, R.B. Stammers has been studying the performance of two-man control teams working under different task demands and team arrangements.

Stammers used a computer-driven experimental setup with a naval flavor; operators had to identify, track, and report on the movement of (other) vessels in the vicinity. Initial contact data came in the form of range and bearing of the target; a track tag or label was given to each one and checked; then the contact (with its label) was plotted by the operator via X-Y keys. A plan layout of all points plotted was available, and all significant changes in course or speed were reported verbally to another operator. As the targets were originated and clocked by the computer, the setup automatically provided two time scores: (1) waiting time, the interval between first appearance of the target and the time its processing started, and (2) processing time, which included labeling, plotting, and communicating. Some quality scores were also provided routinely such as the number of incorrect label assignments.

Two types of organization were tried: vertical and horizontal. In vertical teams, the first operator did all the identifications and labeling and the second operator did all the plotting and communicating. In horizontal teams, each member had half of the display to manage and did all the tasks within that sector.

To vary task complexity, Stammers set the number of targets to be processed at three different levels: 4 targets per 2 min 40 s, 4 per 2 min and 4 per 1 min 20 s. As expected, the more targets operators had to handle, the longer were the response times. But the horizontal operation was more efficient, mainly because under high load, the first vertical operator could not keep up with the labeling requirements.

A second experiment increased the total number of tracks (4, 6, and 8) while holding the average rate and presentation at a medium load. Here too, the horizontal total-task scheme produced significantly better response times, with the vertical organization of work being especially unsuitable when the first operator had to attend to eight target movements.

The third working environment had signals that crossed over the sector barriers between operators. In that arrangement there were no significant differences between horizontal and vertical response times, although the general trends toward horizontal superiority were as before. In addition, although the communications between operators increased with task complexity as expected, the communications often did not seem to help very much.

In a final experiment, Stammers imposed an additional constraint: a "status report" also had to be filed

by means of a question-and-answer format at the computer terminals. This meant that the second vertical operator and both horizontal operators had an extra task to perform. Most of the results observed can be explained in terms of average "reasonable behavior" hierarchies. For instance, when the system asked a horizontal operator for a status report, the operator usually would complete the processing on the track immediately under his attention and then start on the status report. In the vertical setup, the first vertical operator would not even know about the status report needs, so he would have short waiting times. But the vertical process time required by the second operator was high because there were often several labeled targets queued up and ready for processing. The advantages and drawbacks for each system resulted in total times that were not appreciably different for most of the comparisons.

Overall, Stammers showed that complex signal processing is often inefficient in a strict vertical organization. The first operator may be overloaded and the second operator underloaded, or vice versa. A horizontal processing setup permits approximately equal loading at all phases of the task, and things are even better if there is a fair degree of intra-task organization. For a horizontal operator, the detection, plotting, and reporting subtasks were integrated into a rather smooth sequence. But the new requirement for the status report moved outside this smooth flow and required look-up and inference activities using a list of data. And so the superiority of the horizontal organization was much attenuated.

People familiar with real control centers such as Naval Combat Information Centers would find the Aston experiment rather bare. Stammers had no extraneous noise, no people milling around, no unexpected command request for totally new data or analysis, no real emergencies to handle, just several terminals in a room. Also, the signals and numbers were clean and unambiguous in contrast to the uncertain inputs from real radars and track monitors. In a real system, tagging often is done automatically nowadays by "hooking" the target with a track ball or joystick; this establishes and enters the new track and starts a projecting and correlating routine. But studies like the Stammers series do indicate the extent to which performance can respond to elementary team organization parameters.

Complexity was defined in the Aston experiments by the quantitative variations

in number of units processed. It should be interesting to compare the horizontal-vertical organizations when different kinds of processing are demanded of the operators. The decisions regarding allocation of target detection and classification effort, in the real case, often are made by relatively low-level people in the system, those right at the terminals. Would a horizontal configuration be best for such determinations?

Industrial psychology often favors horizontal structures because individuals and teams can have more flexibility and more room to innovate, and so the tasks themselves are more interesting and varied. For these reasons, it is confirmatory to find at Aston that a horizontal type of organization stands up well in a rather strict performance comparison. As some conditions in the experiments yielded good performance under vertical task allocation, it appears that a rather complicated situational analysis will be required to recommend an organizational structure for any specific case.

Nicholas A. Bond, Jr.

ONR London

TOBACCO USE: SMOKERS, SNUFFERS, AND STOPPERS

Tobacco smoking is a major problem all over the world. On the public health side, smoking is correlated with a long list of ailments. Among the best publicized are cancers of the lung, larynx, esophagus, and oral cavity. Actually, respiratory involvements are more frequent than malignancies; every doctor sees patients with the "smoker's syndrome" pattern of dyspnea, wheezing, pharyngeal constriction, reduced ventilatory efficiency, and greater risk of emphysema. In at least some groups of people, there are increased cardiovascular risks. To this array of health hazards must be added the costs of tobacco production and distribution, the irritation of smoke to non-smokers, and a wide assortment of property and accident risks. About one third of the hotel fires in London are attributed to the improper disposition of smoking materials, and many industrial explosions, fires, and accidents are credited to the same source.

There is no doubt that public health programs tend to reduce smoking over a period of many years. In 1964, when the famous US Surgeon General's report was issued, about 52.9% of adult US males

were smokers and 22.2% were former smokers. By 1975, only 39.3% were smokers and the percentage of former smokers had increased to 29.2%. The comparable figures for US adult females were 31.5 and 7.4% for 1964, and 28.9 and 14.5% for 1975. In Britain, research at Maudsley Hospital, Beckenham, Kent, has shown that, when a doctor urges a smoking patient to stop smoking and provides information about doing so, about 5% will quit. Because of this low but significant success rate, some 25,000 British doctors are now being provided with a new "kit" of leaflet materials.

But experimental smoking programs are typically ineffective. With behavioral techniques such as rapid smoking aversion (one puff every 6 s), electric shock, desensitization, or stimulus control, the net effectiveness of the treatment is on the order of 10 to 15% in volunteer samples. Thus, if 1,000 people appear in response to an advertisement for free behavioral treatment for dependent smokers, and the respondents are randomly split into treatment and control groups, we should expect about 40 to 60 in the control group to quit, and maybe 75 to 125 "stoppers" in the treatment group. The treatment still might be considered worthwhile, but the great majority remain unaffected by it.

A special nicotine-based chewing gum marketed under the brand name of Nicorette may prove to be an effective anti-smoking aid when it is used under a planned regime. The gum, which was first developed in Sweden, comes in two strengths, 2 and 4 mg. When the gum is chewed over some minutes, the nicotine is delivered to the bloodstream via the lining of the mouth (any nicotine that is swallowed is broken down by the liver, and hence does not reach the brain). Dependent smokers are advised to chew one piece of gum slowly when the urge to smoke is very strong. It takes 20 to 30 min for most of the nicotine to be absorbed into the bloodstream. As inhaling smoke brings nicotine to the brain in only 7 s (faster than an intravenous injection), patients who use the gum are warned that the gum does not give the same "kick" as a cigarette, but they are also advised that it will reduce the desire to smoke and that it may help to alleviate other withdrawal symptoms such as irritability, loss of concentration, and hunger for carbohydrates. It is thus clearly an aid and not a miracle drug.

In a trial run at the Addiction Research Unit, Institute of Psychiatry, London, 69 patients were started on the gum. They met in small groups, were

given a few weeks' supply of gum, and were told how to use the product. Presumably because of the bad taste and the disagreeably hot tingle at the back of the throat caused by the nicotine, 15 people stopped chewing it during the first week; only 2 of the 15 stopped smoking within a year. One month into the treatment, the average gum consumption for the remaining 54 subjects was stabilized at about 8 pieces a day. In a follow-up study at the end of a year, 26 (38%) of the original 69 in the gum-treatment group had stopped smoking altogether. The claims of abstinence were checked by analyzing carboxyhemoglobin concentrations or expired air carbon monoxide; the research group had standard methods for doing these checks. In a comparison behavioral-treatment group of 49 control subjects, only 7 (14%) were found to be totally abstinent at the 1-year followup. Another trial with 126 subjects was completed recently; it yielded slightly better results, with just over 40% of gum users abstinent after 1 year.

The gum treatment seems to be quite effective and it is almost certainly cost-effective. A package of 105 pieces of gum costs about \$13.50, so a person under an active gum-aided regimen would spend about a dollar a day for the gum. With British cigarettes selling at \$1.60 a pack and an average use of a pack or more a day, the direct costs to the smoker are on the order of two or three dollars per day. Also, it turned out that about three-quarters of the people in the gum-user group stopped chewing it after 3 months, only 2 of the 69 people became addicted to the gum itself, and only 6 needed to chew the stronger, 4-mg version in order to stay off cigarettes.

Reliable numbers for a more general cost-effectiveness tabulation are difficult to obtain. But the number of life years saved by stopping smoking is so immense, and the health-care costs of smoking-related diseases and deaths so exorbitant, that a treatment promising 40% success should be cost-effective by almost any calculation. UK health authorities attribute 100,000 premature deaths every year in Britain directly to smoking, and their estimates of related hospital and medical costs run to many millions of pounds.

Given the experimental results of using Nicorette and its obvious cost-effectiveness, we should expect that public health authorities would be eager to support such a product. At present, however, the UK Department of Health and Social Services has not allowed the gum to be prescribed on a National Health Service prescription; the reasons are unclear, although one senior health official stated that stopping smoking was only

a matter of will power! Ireland does consider the gum a prescribable drug and it is now being dispensed in that country; about 40% of Irish citizens receive totally free drugs.

The Addiction Research Group has also been studying nicotine intake by snuff users. About half a million people in Britain use "dry snuff"; the vast majority of these sniff it into the nose (unlike the "wet snuff" users in America and Scandinavia who place the ground tobacco in the mouth between the gums and lips). The change in plasma nicotine concentration from sniffing a pinch of snuff resembles the change observed in smokers who inhale one cigarette. But this holds true only for experienced, or daily snuff users; novices may sneeze the snuff away and show no discernible plasma nicotine change. An unusual observation was made on the snuff-taking champion of a British society of snuff enthusiasts. The man, aged 65, was encouraged to take multiple doses of snuff in rapid succession, which he did. The resulting concentrations of plasma nicotine (797.2 nmol/l) and maximum plasma cotinine (5,863 nmol/l) in his blood were believed to be the highest ever recorded in man; for reference, the highest comparative numbers observed in a sample of over 400 heavy smokers were 474.7 and 4,310, respectively.

Investigators at the Institute of Psychiatry (J.J. Jarvis, M. Raw, C. Feyeraabend, and M.A.H. Russell) believe that the similar blood concentrations produced by smoking and nasal snuff-taking implicate nicotine as the main addictive element in tobacco use. They also suggest that snuff-taking might prove to be an acceptable substitute for many of those who are trying to stop smoking. Snuff use does not involve the tar, carbon monoxide, nitrogen oxide, and heat of tobacco smoke, so for dry snuff users there should be no additional risk of lung cancer or emphysema. For wet snuff users, there is increased risk of oral leukoplakia, and in certain groups, such as those over 60 years of age, increased risk of oral carcinoma. On balance, and particularly for heavy-smoker cohorts, snuff-taking may be a more acceptable alternative and one that can be readily studied regarding its own addiction-breaking aspects.

The cigarette smoker may actually want the tar in the smoke along with the nicotine. Manufacturers have argued that, if people are offered cigarettes with medium nicotine and low tar, the smoker would be provided with nicotine, but there would be a lower cancer risk.

Last year in Britain, for instance, the industry voluntarily agreed to reduce the average tar yield of cigarettes from 16.5 mg to 15 mg, as measured by a "smoking machine", which takes a standard puff every minute. But Robert Stepney, a psychologist working at Addenbrooke's Hospital in Cambridge, found in a sample of 19 smokers that the smokers obtained about the same amount of tar and nicotine regardless of whether the cigarettes they smoked were nominally low-tar, extra-nicotine, or normal products. He believes that experienced smokers may, for example, take more short puffs when the nicotine and tar components are reduced or filtered. And market statistics show that if tar is reduced to extremely low levels, as in the British "ultra-mild" cigarettes, almost nobody will buy the product.

The Nicorette gum "boom" seems to have given a new momentum to tobacco-use research in the UK. By some estimates, 100,000 people will be using the product next year in Britain alone. The UK Thoracic Society is now conducting a large trial with the gum, and the coded result of that study will be broken sometime in 1982. According to British authorities, the product is under investigation by the USFDA and soon may be prescribable in America.

As physiological measurement techniques and treatment possibilities become more standardized across projects, tobacco addiction should become better understood and hence easier to manage. For those who want to stop using tobacco products, there may soon be a hierarchy of using and aiding treatments, with practical advice on how they can be applied and monitored.

Nicholas A. Bond, Jr.

ONR London

BIOLOGICAL SCIENCES

INTERNATIONAL SYMPOSIUM ON RECENT
ADVANCES IN ENTERIC INFECTIONS, BRUGES,
BELGIUM, 8-11 SEPTEMBER 1981

Acute gastrointestinal infection plays an important role in the majority of the world's population and stands high among the killing diseases of childhood. Until a few years ago, a specific pathogen could be isolated from at best 20 percent of patients with acute gastroenteritis. The use of refined procedures

has increased the possibility of enteropathogen detection to 60 percent in cases of acute diarrheal syndrome. The purpose of this international symposium was to examine the current global magnitude of the problem of enteric infection and to discuss the fundamental advances in physiological, microbiological, epidemiological, and clinical aspects of acute diarrheal disease.

The organizing committee consisted of Dr. Herman W. Wan Landuyt, St. John's Hospital, Bruges; Dr. J. P. Butzler, St. Pieter's Hospital, Brussels; and Dr. P. Piot, Institute of Tropical Medicine, Antwerp. Over 250 participants from 25 countries gathered in the historic city of Bruges for the symposium. The program consisted of presentations and poster sessions by experts in the numerous disciplines encompassed in the study of enteric disease.

Appropriately, the first paper was given by Dr. M. H. Merson, manager of the WHO Diarrheal Diseases Control Program. Merson stressed the commitment of the program to the immediate objectives of reduction of mortality caused by diarrheal diseases and their associated ill effects, and the longer term objective of reduction of disease morbidity and promotion of self-reliance of countries in disease control. With major water supply and sanitation problems still existing in developing countries, current emphasis is placed on early home therapy including oral rehydration and nutritional management along with the promotion of child care and environmental health practices. The program also is committed to providing research support towards development of new and better drugs for treatment and new or improved vaccines against the causative agents of diarrhea. With full implementation of the WHO Program, Merson estimates the prevention of 1.5 million diarrheal deaths by the year 1990.

Following that introduction to the problem, Dr. Jan Holmgren (Univ. of Göteborg, Sweden) gave an overview of the fundamental mechanisms in enteric infections. With an eye toward exploitation of basic disease mechanisms for the design of new prophylactic or therapeutic agents, he surveyed microbe-host interactions in three prototype bacterial enteric infections: (1) cholera and enterotoxigenic *E. coli* (noninvasive, toxin-related); (2) *Shigella* dysentery (tissue invasion); (3) *Salmonella* gastroenteritis (colonization and inflammatory response). Common to all enteric diseases is the process of colonization of the intestinal tract, involving microbial attachment to and penetration of mucus,

and adhesion to the epithelial cell. Control of one or more of the steps in this process may be an important means of eventual control of many enteric diseases.

Subsequent presentations detailed aspects of specific pathogens and their roles in the production of enteric disease. Numerous papers at the symposium dealt with specific pathogens or diseases: *E. coli*, *Clostridium difficile*, *Campylobacter jejuni*, cholera, Salmonellosis, Shigellosis, amebic dysentery. Dr. Bernard Rowe (United Kingdom) discussed the groups of pathogenic *E. coli*, including the "enteropathogenic," "enterotoxigenic," and "enteroinvasive" varieties. Enterotoxigenic *E. coli*, he stated, is one of the most important etiologic agents causing infant mortality in developing countries. Recent advances in the understanding of virulence factors of this pathogen and an associated knowledge of the genetic control of these factors will likely provide information leading to effective vaccines and a significant reduction in associated infant mortality.

Ability to differentiate toxigenic *E. coli* from *E. coli* that is part of the normal human flora has received much attention. Dr. T. Honda (Osaka Univ., Japan) detailed a screening technique, termed the Biken method, for detection of *E. coli* heat-labile enterotoxin (LT) on agar plates and stated that the test correlates well with the results from cytotoxicity assays.

Identification of toxigenic *E. coli* using methods designed to detect specific DNA sequences for heat-stable and heat-labile toxins was discussed by Dr. Stanley Falkow (Stanford Univ., Stanford, CA). The techniques are applicable to the identification of other disease agents and offer exciting uses for newly expanding recombinant DNA technology.

Prophylactic and treatment methodologies for gastrointestinal disease received attention from several speakers. Dr. T. Wadstrom's group (Biomedicum and Pharmacia, Uppsala, Sweden) discussed experiments in which hydrophobic gels were used to prevent intestinal colonization and diarrhea by enterotoxigenic *E. coli* in an infant rabbit model.

In many diarrheas, irrespective of etiology, life-saving therapy consists of prompt replacement of water and electrolytes. Dr. Myron M. Levine (Univ. of Maryland School of Medicine, Baltimore) presented a thorough overview of oral rehydration procedures which effectively can replace intravenous rehydration. The key to the success of the method is that the materials for the oral sugar-electrolyte solutions, available in packets

in many health care facilities worldwide, are inexpensive, easily transported, and do not have to be sterile. In some areas of the world where proper utilization of the packets is impractical, educational programs present information on methods whereby mothers can prepare and use sugar-salt solutions with supervision on a village level. Dr. Levine stressed the considerable benefits to be gained from an active program of oral rehydration, a program that provides a cornerstone for diarrheal disease control in less developed countries.

Dr. W.B. Greenaugh III (Bangladesh) reviewed measures that employ antibiotics and pharmaceutical agents in the control of diarrhea. Treatment for diarrhea revolves around four approaches: kill the infecting agent; decrease fluid loss; block receptors to which the organisms or toxins attach; enhance defenses. While candidate drugs to impede secretion or enhance absorption are under investigation, none is applied routinely.

An effective vaccine or prophylaxis for cholera has been a goal of many investigators. Greenaugh mentioned a field trial using the B subunit of cholera toxin to block receptors and prevent attachment of the actual toxin. Dr. John P. Craig (Downstate Medical Center, Brooklyn, NY) discussed the complexity involved in the development of a vaccine for cholera. Identification of critical protective antigens is a prerequisite for development of an effective vaccine. Also important, Craig stressed, is the assessment of the significance in pathogenesis of structural antigens associated with motility, penetration of mucus, and adherence to the mucosal surface, as well as of extracellular products other than enterotoxin. A nonliving, oral vaccine containing both bacterial and toxin-derived antigens probably will prove to be the most practical and effective cholera immunogen.

Campylobacter jejuni recently has been recognized as an important cause of acute diarrheal disease in many countries. A wide variety of papers dealing with clinical features, isolation, growth, identification of the organism, and serological studies attested to the significance of this pathogen in the field of enteric diseases.

The disease picture of *Campylobacter* enteritis was discussed by Dr. J.P. Butzler (St. Pieter's Hospital, Brussels). Clinically the disease can range from symptomless to severe, with fever, abdominal pain, and bloody diarrhea common. Differential diagnosis is important to distinguish it from ulcerative colitis, proctitis, and inflammatory bowel disease.

Serological identification of *Campylobacters* is complicated by the variety of serotypes of the organism. Dr. Sabine Lauwers (Free Univ., Brussels) has been studying the problem with strains from Belgium, South America, Africa, and Bangladesh and has found those from Belgium to possess several common serotypes while many of those from elsewhere were untypable with currently used antisera. Dr. J.L. Penner (Univ. of Toronto) has found 8 predominant serotypes that composed 66 percent of the over 800 isolates tested. A variety of other papers indicated the interest in *Campylobacter* serology.

The state-of-the-art in isolation of *Campylobacter* was presented by Dr. Ray Kaplan (Rush-Presbyterian Hospital, Chicago, IL). His group has developed a system using a polyethylene bag (Poly-Bag System) filled with the appropriate atmosphere (5% O₂, 10% CO₂, 85% N₂) that provides an inexpensive and efficient method for primary culture of the organism. For growth of *Campylobacter* after isolation, Dr. J.C. Coolbaugh (Naval Medical Research Institute, Bethesda, MD) presented his group's biphasic media technique for high-yield, rapid growth without elaborate atmospheric requirements.

The wide diversity of topics covered at the symposium precludes a complete overview in this discussion. The meeting was an unqualified success in bringing together from all parts of the world scientists who have the common goal of prevention and control of diarrheal disease. The global-scale effort and the enthusiasm and dedication displayed at the conference made the goal look somewhat more achievable than before.

James C. Coolbaugh

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CHEMISTRY

32ND MEETING OF THE INTERNATIONAL SOCIETY
OF ELECTROCHEMISTRY IN DUBROVNIK/CAVAT,
YUGOSLAVIA: 13-20 SEPTEMBER 1981

Electrochemistry is undergoing a renaissance internationally and this meeting, with approximately 500 participants from 36 countries and 300 contributed papers on virtually all phases of electrochemistry, reflected that revival. All contributed papers were presented in poster sessions followed by discussion sessions. The meeting had two major

themes, fundamental aspects of electrochemical energy conversion and metal deposition and dissolution, with one plenary lecture on each. In addition, the seven divisions of the society had sessions devoted to their particular specialties: electrolytes and electrochemical thermodynamics; electrochemical physics; organic and bioelectrochemistry; electrochemical energy conversion; corrosion and electrochemical surface treatment; and electrochemical engineering. A keynote lecture was presented in each of these areas.

Prof. W. Vielstich (Univ. of Bonn, FRG) presented the plenary lecture on recent developments in batteries for electrotraction. Vielstich reviewed the requirements for secondary batteries for vehicle propulsion in West Germany. According to studies of the Gesellschaft für Elektrischen Strassenverkehr, a substantial part of West Germany's need for imported oil for energy can be satisfied with coal- or nuclear-generated electric energy if storage batteries of adequate performance become available for automobile, bus, and truck traction. The traffic statistics for West Germany and other similar regions of western Europe indicate that the average mileage for passenger cars as well as trucks and buses is less than 60 miles per day per vehicle. Consequently, even some of the nearer term battery systems now being developed or improved may have a substantial impact in Europe provided adequate cycle life (e.g., 1,000 cycles) can be achieved.

The lecture addressed the state of the technology and recent developments related to several specific systems. Vielstich stated that an improved lead-acid system (affording 50 W-h/kg at the 5-h rate and 35 W-h/kg at the 2-h rate with 1,000 cycles at the latter rate) is still the primary candidate for vehicle propulsion, particularly in view of the slow progress that is being made in developing several of the higher energy density systems. Field testing of electric buses in three West German cities has demonstrated that today's lead-acid-cell technology is sufficient for this application. Vielstich briefly discussed the problems that limit present cycle life, the oxidation of the expander materials in the positive electrode and the formation of a high-concentration acid layer at the bottom of the cells. Progress is being made in coping with these problems, the former through the use of new expander materials and the latter by convection in the electrolyte.

Vielstich described progress in several longer term systems including

the following: the sodium-sulfur cell using ceramic electrolytes; the lithium-aluminum-iron sulfide cell using molten alkali halide electrolytes; the nickel-zinc cell using aqueous KOH electrolyte; metal gas systems including zinc-chlorine, aluminum-air, and hydrogen-air fuel cells. Vielstich described in somewhat more detail the developments in the sodium-sulfur cells, particularly with respect to problems with the β -alumina ceramic electrolyte tubes and alternatives to this electrolyte including TITZICON ($\text{Na}_{0.1}\text{Zr}_{1.5}\text{Si}_{2.5}\text{P}_{0.7}\text{O}_{11}$), which has a higher conductivity and good stability against the Na_2S_x cathodic reactant. He also was enthusiastic about a new powder separator as an alternative to the high-priced boron nitride separator used previously for the LiAl-FeS cells developed by Argonne National Laboratory in the US. The new powder separator electrolyte cell has already afforded more than 500 cycles with 80 to 90% utilization of the FeS, and it is cheap to fabricate. Vielstich was not very enthusiastic about the nickel-zinc battery because of the problems of zinc dendrites and shape change (redistribution of zinc) that have not been solved yet.

A keynote lecture in the same subject area was presented by Dr. E.J. Cairns (Univ. of California, Berkeley) on advanced rechargeable batteries. Cairns discussed both ambient- and high-temperature systems including a number of those considered by Vielstich, but he emphasized developments that have occurred principally in the US including the use of Li_4Si in place of LiAl in the Li/LiCl-KCl/FeS cell; the Na/Na⁺ glass/S high temperature cell of Dow, and the Na/ $\beta''\text{-Al}_2\text{O}_3/\text{SCl}_2/\text{AlCl}_3$ cell of G. Mamantov.

The second plenary lecture was presented by Prof. A. Despic (Univ. of Belgrade, Yugoslavia), who spoke on the present status of understanding of electrodeposition and dissolution and discussed some challenging problems in this area. In addition to giving a general review, Despic cited several specific developments in which the Belgrade group has made major contributions. These include: (1) the development of analogs to the Pourbaix diagrams indicating regions of stability for various adsorbed hydroxide species and bulk phase species in plots of potential vs pH for systems such as iron; (2) the role of underpotential deposited metals on foreign metal substrates and the effect of such layers in electroplating; and (3) the importance of numerical computing techniques in analyzing the sensitivity and accuracy of experimental methods, the role of various experimental parameters in complex electrode processes, and the carrying out of model calculations.

Other keynote lecturers included D. Dolar (Kardelj Univ., Ljubljana, Yugoslavia) who reviewed the theoretical models and treatments for transport phenomena in polyelectrolyte solutions; K.E. Heusler (Technische Univ., Clausthal, FRG), who discussed the factors controlling the kinetics of electron and ion transfer processes at oxide electrode-electrolyte interfaces; R.R. Dogonadze (Georgia, USSR and Inst. of Electrochemistry, Moscow), who discussed the quantum statistical thermodynamics of electrode processes including photoelectrochemical processes with emphasis on the work of the Soviet school, of which he has been leader over the past 10 years; and I. Tabakovic (Djuro Pucar Stari Univ., Banja Luka, Yugoslavia), who discussed the synthesis of heterocyclic compounds by the anodic oxidation of hydrazine. Prof. M. Froment (CNRS Physique des Liquides et Electrochimie, Paris) was unable to attend and his lecture was presented by his colleague, R. Wiart. The lecture emphasized structural and morphological aspects of metal deposition and included a discussion relating both to models and to experimental work in electrocrystallization. (Three of the keynote lectures were not presented, and this left a considerable hole in a program that had a total of only eleven oral presentations.)

The program also included three round-table discussions: (1) The Controversial Aspects of Electrochemical Theory - chairman, J. O'M. Bockris (Texas A&M Univ., College Station, TX); (2) Engineering Design of Electrochemical Converters: The Role of Mathematical Models - chairman, J.R. Selman (ITT, Chicago); (3) The influence of Structural Characteristics of Metal on Corrosion Behavior - chairman, A. Mihajlovic (Yugoslavia). The round-table discussion on theoretical aspects involved a statement by Bockris of what he considered to be important controversies in theoretical electrochemistry in the following areas: (1) the question of how the applied potential at an electrochemical interface affects the Fermi level in the metal electrode; (2) models for the semiconductor electrolyte interface and particularly the lack of applicability of the Schottky barrier model to such interfaces; (3) the meaning of the Fermi level for a redox couple in the electrolytes and the questioning of the assumption that the Fermi level in the solution corresponds to that of the electrode when the electrode and solution phase redox couple are at equilibrium; (4) the question of surface states in semiconductor electrode surfaces and

particular induced surface states caused by specifically adsorbed anions; (5) the importance of the inner sphere reorganizational energy in electron transfer processes and the neglect of such by theorists in some of the early work (but not by the principal theorists in recent years). Despite the presence of several theorists and much discussion, the round table did not lead to new conclusions and would have been more effective if clear position statements had been made by several theorists and the subject matter somewhat more limited. The round table did stimulate much discussion.

The poster sessions contained a number of interesting papers on the following topics: ionic conducting solid electrolytes; photoelectrochemical phenomena on semiconducting electrodes including oxide electrodes; electrocatalysis for the hydrogen and oxygen electrode process on surfaces ranging from single crystal platinum to high area oxide electrodes; extensive studies of various processes on single crystal platinum, silver, and other electrodes; lithium electrode behavior in various nonaqueous solvent systems; fundamental studies of RuO₂ electrodes (the Dimensionally Stable Anode of the chlor alkali industry); optical studies of electrode surfaces, principally *in situ* infrared and UV-visible; passivation of metals including iron and lead; underpotential deposition (UPD) on various metal substrates, particularly single crystal substrates; electrocrystallization phenomena including zinc and dendrite formation.

On the whole, the Yugoslav host committee under the chairmanship of B. Lovrecek did an outstanding job in organizing the meeting.

Ernest Yeager

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COMMUNICATIONS SCIENCES

LABORATOIRE D'INFORMATIQUE POUR LA
MECANIQUE ET LES SCIENCES DE L'INGENIEUR
(LIMSI), FRANCE

LIMSI, in the Paris outskirts of Orsay, is one of the many laboratories run by CNRS, France's counterpart to the US National Science Foundation. It was described in ESN about 5 years ago (ESN 30-8:361 [1976]). At that time, LIMSI's program primarily emphasized aerodynamic and hydrodynamic problems, but it also

gave evidence of a secondary interest in computer graphics and some activity in speech synthesis systems. Since the liaison visit reported in the above ESN article, things have changed considerably. About 2 years ago, the director, Prof. L. Malavard, retired, and the laboratory has undergone a significant reorganization and redirection. Last year the Computer Graphics Group was disbanded, and many people from that group formed a company now working on the development of EUCLID, a computer-aided design language for use by architects. The Robotics Group, under the direction of Dr. A. Osorio, which was organized some 3 years ago and contains about half of the total staff, has become the largest of the three groups that make up LIMSI today. The Speech Group, under the direction of Dr. Jean-Sylvain Lienard, has also matured; it constitutes about a third of the staff and, as discussed below, its range of interests has been extended to support the robotics interests of LIMSI. The third group, now somewhat isolated from the mainstream in the laboratory, is the Hydrodynamics Group which, as reported in 1976, is under the direction of Dr. T.S. Luu.

My host was Dr. Lienard. In the absence of Osorio, Lienard provided a thumbnail description of the activities within Osorio's group. Robotic systems might be decomposed into three subsystems: sensors, manipulators or activators, and the intelligent management of the overall system operation. At present, LIMSI's robotics activities are limited to the sensor and management subsystems, and Lienard's group supports the latter subsystems through the development of man-to-machine and machine-to-man communications by way of speech. Eventually, that overall development will include three aspects of speech processing: recognition and interpretation, bandwidth compression (for efficient transmission, if necessary) and speech synthesis. Up to now, the group has concentrated on the recognition and synthesis problems; Lienard feels that the bandwidth compression question can best be left unresolved until the recognition and synthesis algorithms are developed. The algorithms will suggest the particular features of the signal that need to be encoded.

Speech synthesis has been under study at LIMSI since 1968. In the early years, the Speech Group developed an analog system, called ICOPHONE, which used photoelectric detectors to sense the time-varying envelope in a display of the speech spectrogram and then re-generated an approximation to the spectrum

through a rather complex set of hardware: 44 fixed-frequency oscillators, 2 noise generators, and the equipment necessary to "match" the envelopes of the spectra. In 1974, the group developed another version of ICOPHONE, one that operated on textual inputs and synthesized the speech by reproducing strings of diphones. (The full set of dihone-generating instructions was stored in a read-only memory.) That system originally was designed to work with the IBM-1130 minicomputer. The newest version, called ICOLOG, operates on the same general principle, but, besides having been redesigned to work with the Intel 8085 microprocessor, it has the capability to generate a limited set of markers for the prosodic elements of speech, the stress, rhythm, etc. By using those markers as control signals, ICOLOG synthesizes a more natural sounding audio signal. The prosodic data must be developed from a much higher level of speech than the dihone, of course, and in general, this is still a very active area of research in the speech synthesis area. For ICOLOG, the group is using an algorithm based upon the partition of "concepts", i.e., phrases, and their location within the sentence. This algorithm was developed by Dr. D. Memmi, a member of Lienard's group, and was described in May 1979 at the 10th annual Journées d'Etudes sur la Parole (JEP) in Grenoble and in the proceedings that are published under the same title. (JEP is the annual conference sponsored by the Speech Communication Group of GALF, an international association of French-speaking acousticians, which, as one of its explicitly stated tasks, has to provide its members with an opportunity to publish their work in French.)

The speech recognition studies at the laboratory have dealt with both isolated-word recognition and continuous speech. In the isolated-word case, a system called MOÏSE was developed. (It has recently been offered as a product by the Vecsys Company of Meulan.) One of LIMSI's staff took pains to explain the French pun involved in that name—*moï isolé* means isolated word; *Moïse* also means Moses, who received the Word on Mount Sinai.

MOÏSE derives spectral data through an eight-channel analog filter bank that covers the 200 to 5,000-Hz range. Log-amplitude data, at eight bits per sample, are processed to derive transition characteristics. This step results in the generation of a set of descriptive vectors every 10 ms. The second step compresses the representation of a whole word to a fixed-length set of 30 vectors; the compression is accomplished by choosing those 30 of the available vectors

that describe best the non-steady-state parts of the word. Because time distortions are consciously introduced at this step, dynamic programming is necessary at the pattern-matching step to compensate for the distortions. The requirement for dynamic programming exists in addition to the conventional requirement, which is meant to compensate for the difference in the duration of spoken words inadvertently introduced by the user between the training set and the operational set.

MOISE is based on the Intel 8085A microprocessor, and the whole system fits on one circuit board. If it operates as a stand-alone system, 8 Kbytes of PROM are required for the program; as an auxiliary system, it requires half that amount of memory. In the training step of the operation (it is speaker-dependent), MOISE accepts a 65-word vocabulary with a requirement for pauses between words of about 200 ms. The Speech Group is modifying the system in an attempt to increase the vocabulary capability to 100 words. In operation, the recognition time is less than a half second with a measured accuracy of about 99% on a vocabulary of the numerical digits. Besides trying to increase the size of the vocabulary, the group is planning to introduce a quick-talk mode, which will operate with pauses of only about 15 ms between the words, and a "lucky Luke" mode, which will attempt word recognition before the end of the word. It also plans to increase the vocabulary through the use of syntax, and to modify the algorithm in an attempt to use MOISE as a connected-word recognizer for sequences of up to about 10 words.

As one example of the use of this type of system, a member of the group, Francoise Neel, has been studying the possible use of speech input to an automatic FORTRAN-language programming device. In this application, a dictionary of about 110 words was considered necessary. The study highlighted the need for a syntax analyzer that would restrict the size of the current dictionary to a more easily processed set.

In the area of continuous-speech recognition, Dr. Joseph Mariani has been developing a system that he calls AESOP. The acoustical spectral data are derived by a 16-channel vocoder. Then segmentation to derive phonemes is followed by the use of syntax and semantically directed attempts to find a "best" path through the range of uncertainties.

Mariani presently has a 40-word lexicon with a branching factor of 10. In the original configuration of the

system, he used only the four best guesses for each phoneme to find a path; lately he has allowed the algorithm to accept all of the "possible" guesses. He has also recently modified the algorithm, basing the search on diphones rather than phonemes. Using this technique with only a 20-word vocabulary, he reported essentially error-free operation for a single speaker.

Some fundamental research is going on within the group to measure the variability between speakers. This is an attempt to derive a set of invariants upon which virtually speaker-invariant recognition systems could be based. The work is being done by Maxine Eskenazi, a doctoral student in linguistics who received her undergraduate degree at Carnegie-Mellon University. Using multiple utterances of 21 phonemes by about 30 speakers, she has analyzed the data on the radii of curvature of the spectral envelope of those signals in a few regions of the spectrum. The initial results of this limited experiment appear to be promising. In the region of 1 kHz, some of the phonemes appear to be unambiguously classifiable by this parameter; the search goes on for a set of regions to provide a more complete classification.

Lienard's group of about a dozen researchers represents one of the significant speech-oriented activities in France. With its co-located robotics-systems-oriented colleagues, the group can be expected to inaugurate an interesting new era for LIMSI.

In the course of the day, the mention of Moses coupled with the comment that hydrodynamics had been deemphasized at LIMSI evoked an image of the parting of the Red Sea—right there outside Paris—but, as you know from a careful reading of recent newspapers, it didn't happen.

Philip Fire

ONR London

COMPUTER SCIENCES

CENTRALIZED GOVERNMENT MANAGEMENT INFORMATION SYSTEM IN ISRAEL

In the late 1950s, the government of Israel recognized the need to establish a separate governmental data processing center to meet the ever-increasing demand for services in systems analysis directed to the design and maintenance of ADP information systems. The Office Mechanization Center (OMC) in Jerusalem was created

under the aegis of the Ministry of Finance as an independent entity. Its main functions include: (1) design, planning, and programming of integrated and coordinated interdepartmental projects; (2) operation of national data bases; (3) assistance in the formulation and implementation of the government automation policy; (4) facility management for government computer installations; and (5) training of government ADP personnel.

The unusual aspect of being an independent entity in the government is that OMC conducts its activities in a commercial-industrial manner. The total 1981 budget of \$15 million was derived from its own earnings. Loans for development and equipment are amortized in 3 to 5 years. Charges to customers, which are on a contractual basis, are assessed according to rates for various services in systems analysis, programming, and computer use. However, OMC does not enjoy a monopoly in governmental ADP services and operates under competitive conditions in that any government office is free to obtain the same or better services anywhere. Therefore, OMC is obliged to function efficiently under such a cost accounting framework. In short, OMC is a nonprofit free enterprise within the Israeli government.

Applications & Services

At present, OMC has 330 employees, two-thirds of whom are technical personnel devoted to applications and services. In some cases, the development, design, and programming of a system are done by OMC, while in other cases the responsibility of OMC is limited to consultation or to the provision of computer time. The OMC application systems have been developed according to the following general philosophy: (1) development of information systems and data bases that have the highest commonality among information systems in the government, (2) appropriate use of data-base and teleprocessing technology in a batch or on-line mode in conjunction with the OMC computation center, (3) decentralized input-output productions at user facilities. Some of the OMC application systems are described briefly below.

Population Data Base. Under the jurisdiction of the Ministry of the Interior, OMC maintains the on-line data base on population for all governmental departments and institutions.

Foreign Trade Information System. Clearance of imports and exports is done in the customs offices and at customs brokers via terminals connected to the OMC computer, which monitors the procedure

and computes the tariff. The on-line clearance is coupled with the data bases of foreign trade, population, and corporations, which are maintained by OMC and updated accordingly. Some of the organizations having access to the system are Customs and Excise, Income Tax, Ministry of Statistics, Bank of Israel, and Ports Authority.

Health Information System. Comprehensive information on patients in all government hospitals is compiled and updated for accounting and statistical purposes. A medical data base on history and diagnosis for all patients in all hospitals is being developed.

Utility Accounting System. An on-line information system on payments of license fees for radio and television is maintained for the Broadcasting Authority. The system is being expanded to include the Electricity Corporation.

Voter Register. On the basis of the population data base, a voter register is compiled and detailed lists are prepared for each polling station prior to each election. Statistics on the network of polling stations and voters are also compiled during each election.

In addition, government payrolls, social welfare payments, and statistics are processed by OMC via remote batch terminals. Some of the applications currently under development are:

Telephone Network Monitor. Full information on all telephone lines will be compiled and updated in a data base using the advanced data base software. The system will allow the Ministry of Communication to supervise the line utilization and maintenance. It is expected that the data base will facilitate the reallocation of lines and new installations based on the present network without requiring additional new telephone exchanges. When in operation, this data base will be on-line around the clock.

Corporation Data Base. A corporation data base has been established and its information is being completed from the files and updated by the annual report of each corporation. The data will be used on-line by appropriate authorities and by corporate attorneys and accountants.

Government Accounting. A model of on-line government accounting has been developed and currently is being tested. It will be introduced gradually to various governmental departments. In addition to the current account model and supervision, the system also provides relevant summaries to the Accountant General for overall close monitoring of government finances. Other developments for the Ministry of Justice are at present underway. These include court, police, and frontier control information systems.

OMC Computer Center

The computer center is in Jerusalem. It operates a twin IBM 370/168-3 configuration and serves all the units of OMC in Jerusalem, Tel Aviv, and other sites in local batch, remote batch, and interactive modes. To store the massive data base, there are 20 IBM 3350/3330 equivalent disc drives (up to 9×10^9 bytes). An interesting aspect of the center is that it made a conscious commitment to standardize on IBM software. However, IBM plug-compatible computers and peripherals obtainable from other vendors at lower cost are used widely when feasible. In the twin IBM 370/168 configuration, only one IBM 370/168 with 5×10^6 bytes of storage is coupled with an equivalent plug-compatible National Advanced Systems AS5000 computer. Both computers are running the same operating system (IBM MVS). Resources are distributed such that one computer is devoted to telecommunication and on-line processing and the other to backup, batch processing, and software development. There are 180 OMC or user terminals located around the country and connected to the center.

Summary

OMC is an efficient organization. It is a government service bureau. Consider the \$15 million annual budget and Israel's total population of 3.5 million; the annual per capita expenditure is only \$4. This is an impressive operation for all it has accomplished. Centralization is the key to its success. However, a highly centralized management information system, controlled by the government, with data bases on financial, legal, health, and all other aspects of life on the entire population might give rise to questions relating to personal freedom, security, and access control.

Y. S. WU

ONR London

THE IBM ISRAEL SCIENTIFIC CENTER: AN ULTRASOUND SIGNAL PROCESSING FACILITY

It has been IBM International's policy to establish IBM scientific centers around the world to conduct cooperative research in computer science and related applications in countries that have a sophisticated computer-user community and a pool of highly qualified local researchers. The centers are financed by the profit derived in the country and they are nonprofit in nature.

Research projects are, in general, independent of IBM's corporate R&D programs. The IBM Israel Scientific Center was established in 1972. It is in the same building as the Computer Science Department of the Technion, the Israel Institute of Technology, near Haifa. The basic computation need of the scientific center is served by the Technion Computer Center's IBM 370/168 system. The scientific center is headed by Prof. Josef Raviv, who obtained his PhD degree from the University of California, Berkeley, and worked at the IBM T. J. Watson Research Center, Yorktown Heights, New York, from 1964 to 1972. At present, the center has a staff of 19 scientists conducting research in three areas: mathematical modeling, experimental systems, and software methodology and algorithms. Some staff members hold faculty appointments at the Technion, and Technion computer science faculty members and students participate actively in the IBM Scientific Center's research projects.

One of the major efforts is in the medical application of computer-aided analysis of ultrasound signals and images. Due to the benign nature of ultrasound (1.5 to 15 MHz) and its ability to differentiate between soft and solid tissues, clinical use of ultrasound scanners for radiology and cardiology has been promoted widely. The study is a long-range project in cooperation with the Radiology Department and Heart Institute of Sheba Medical Center, Tel Hashomer, the Radiology Department of Rambam Hospital, Haifa, and the Radiology Department of Vienna University Government Hospital, Austria. The objective of the study is to improve diagnostic capability based on ultrasound data. It involves the restoration and enhancement of ultrasound images and the development of tissue classification techniques. A signal processing facility is needed for the study.

A facility for medical ultrasound image processing has been developed at the center. The main components are an IBM Series 1 (S/1) mini computer, with 128 K bytes of main storage and associated peripherals, which serves as the overall system controller and software interface; a Research Signal Processor (RSP) using reduced computational complexity algorithms for discrete Fourier transform (DFT) and convolution; a Ramtek 9351 gray scale-pseudocolor display with 512×512 16-bit pixels (picture elements); a 20-MHz analog-to-digital converter, and a Picker 80L medical ultrasound scanner. All system interfaces were developed at the center including microprocessor-based high-speed interfaces between RSP and Ramtek 9351 to allow buffered burst block transfers.

The facility is well suited for general purpose signal processing research and studies if appropriate sensor interfaces for a variety of input signals are provided. The S/I is the human interface and system coordinator. Application programs are written in the high-level language PL/I. The RSP performs all image processing computations such as two-dimensional Fourier transforms. The Ramtek display processor presents images before and after processing while also providing a high-speed buffer memory for utilization by the RSP. The commercial ultrasound scanner offers either RF- or envelope-detected (video) signals for the A to D converter and two-dimensional image construction.

The RSP is not a commercial product. It is a research tool developed in conjunction with the IBM Research Center in Yorktown Heights, New York and is optimized for the reduced computational complexity Winograd Fourier Transform (WFT) algorithm (S. Winograd, "On Computing the Discrete Fourier Transform", *Proc. Math. Acad. Sci.* April 1976) instead of the conventional fast Fourier transform (FFT). The add:multiply ratio in WFT is 8 to 1 compared with a ratio of 6 to 4 in FFT. However, input data reordering of WFT is accomplished according to the Chinese remainder theorem and is considerably more complex than the "bit reversal" required by FFT. Furthermore, the considerably more complex and less regular flow of computations in WFT will render an 'FFT pipeline' ineffective. RSP is a 16-bit processor with 100-ns cycle time. The entire processor contains only 4,000 gates. In view of the low multiply:add ratio, no hardware multiplier is included. Multiplication is accomplished by "two-bit at a time" table look-up. Multiply instruction takes 8 RSP cycles. Many multiplications in WFT are by fixed coefficients. For example, to compute a 240-point complex WFT requires 648 multiplications and 5,016 additions. The operation takes 31,900 RSP cycles and 3.2 ms to complete.

The facility supports data acquisition of high resolution ultrasound echo sampling along with angular coordinate and transducer location in the scanning plane. Following a complete scan, RSP does picture composition from individually tracked echo lines. It also can be used to digitize recorded videotapes from the clinical ultrasound scanners for source data. Two-dimensional digital signal processing software using RSP is available for picture management, analysis, and filtering. Some of the preprocessing functions are necessary

for resolution enhancement and normalization before further processing.

Texture analysis software has been developed to support medical diagnosis. A library of source images is available in the form of pathology catalogs of various organs for analysis and experiments. A set of two-dimensional processing functions for spectral analysis, autocorrelation, various histograms, gray-scale intensity slicing, and cross-section profiles is available. Learning and classification support software tools are being implemented with interactive graphics. Central to the task of tissue texture differentiation is the development of reliable discriminants. The features may evolve from signal processing or empirical observations. The facility is a research test bed, in this case for feature specification and verification. It supports the study of local pixel neighborhoods and spatial frequencies associated with these bounded areas. The dimensions of the subregion are variable. The examination subwindow is controlled via cursor through a 256x256-pixel source area centered on texture segments under study.

A significant fraction of ultrasound clinical cases require further examination due to some unresolved aspect. The facility is used to study the feasibility of diagnostic assistance to reduce the number of borderline cases. At present, more images are being analyzed to enhance the medical data base for feature mapping. Other avenues of development are Bayesian multidimensional analysis and elaboration of clustering algorithms. In addition, image enhancement techniques using one- and two-dimensional restoration filters have been evaluated with the system. Simulation programs providing synthetic ultrasonograms have been developed to enable the investigators to simulate interesting cases and to carry out sensitivity studies of the parameters involved. In the field of cardiology, the problem of three-dimensional imaging is being investigated including techniques for data compression.

In short, the signal processing facility at the IBM Israel Scientific Center is a general purpose, programmable, signal-processing test bed that can be used for research in a very diverse field of sciences requiring signal processing. It took the IBM Israel Scientific Center 4 years to complete the facility. At long last, interesting study results should be obtainable by the efficient exploitation of this new resource.

Y. S. WU

ONR London

EARTH SCIENCES

LIGHTNING RESEARCH IN THE IVORY COAST, ITALY, AND FRANCE

This is a report of a trip made by the author and two associates, Dr. Martin A. Uman (Univ. of Florida) and Mr. Gary DuBro (Wright-Patterson AFB), 14 to 25 June 1981, to investigate lightning research activities in the Republic of Ivory Coast, Italy, and France.

The purposes of the trip were:

- (1) to inspect French lightning research programs, to examine the research data, and to discuss the possibility of data exchange and of collaborating on future research;
- (2) to investigate research activities of the Italians in relation to lightning and to suggest similar joint ventures with Italian scientists.

The French currently are conducting major research programs in the Ivory Coast and France on cloud dynamics, atmospheric electricity, and lightning. Considerable resources are being devoted to a long-term study from ground-based and airborne platforms of both natural and triggered lightning and the associated meteorology. Precipitation charging of aircraft and several other aspects of atmospheric electricity are being examined in the field and in the laboratory. The scientific personnel are extremely capable and the recording equipment is among the best available in the world today. The program is managed and coordinated by experimental physicists who clearly understand the important problems as well as the details of the measurements. Although experts in, for example, RF technology, high voltage, optics, atmospheric dynamics, etc., are involved in the work, the French have not yet produced a specialist on lightning, so they are not always sure about how their data can be brought to bear on significant problems. Most of the results to date have been presented as brief papers in unreviewed conference proceedings rather than as full-length papers in reviewed journals.

The Italians have been conducting sophisticated measurements of lightning currents at a mountain site in northern Italy for over 10 years. The work is similar to and complements that of Prof. K. Berger and co-workers in Switzerland, who used less modern equipment. The combined Italian-Swiss data base is now sufficiently large that additional ground-based measurements solely for the purpose of obtaining more statistics on return strokes are probably not needed.

Ivory Coast

Much of the research in the Ivory Coast is funded by a cabinet-level organization called the Direction des Recherches, Etudes et Techniques (DRET) through the Office National d'Etudes et de Recherches Aérospatiales (ONERA). The director of basic military research at DRET, General H. Bongrain, accompanied us in the Ivory Coast. The ONERA research coordinator for atmospheric electricity was Jean-Louis Boulay, who acted as both our guide and our interpreter. ONERA has about 2,000 employees, half of whom are engineers and scientists devoted primarily to aircraft research. Physics research within ONERA is under the direction of Dr. Joseph Talliet. Boulay directs a lightning and electrostatics group under Talliet comprised of about 20 individuals.

The meteorological measurements in the Ivory Coast were being coordinated by Jean-Pierre Chalon, a radar meteorologist with previous experience at the US National Center for Atmospheric Research (NCAR). The combined program on cloud dynamics and associated electrical phenomena is entitled "Etude des précipitations, des phénomènes dynamiques et électriques associés à la convection profonde tropicale" (COPT) and employs about 50 engineers, scientists, and technicians.

The COPT measurements were centered near Korhogo in the northeast part of the Ivory Coast on a flat area of savannah about 50 by 50 km. The following measuring equipment was being used:

- (1) Two 5.4-cm Doppler radars (Ronsard) and associated digital data processing equipment.
- (2) Ten electric field measuring stations, each with a field mill and field change antenna and with data telemetry to a central station. The field mills use 20 stators and the rotor operates at 500 rpm. The dynamic range of the field mills is from 30 V/m to 30 kV/m. The field change (slow E) antennas are operated on four gain ranges, each digitized at 1 kHz. The dynamic range is from 0.3 V/m to 30 kV/m.
- (3) A surface network of 16 meteorological measuring stations.
- (4) Upper-air balloon soundings.
- (5) A tri-antenna acoustic radar system with real-time digital data processing.
- (6) A VHF interferometer for determining the directions of sources of lightning radiation at 300 MHz. The system was designed to provide points at a rate of 300 kHz.
- (7) A wideband magnetic field system for measuring lightning fields from near dc to 20 MHz. The data are recorded continuously on magnetic tape, and the larger

impulses are photographed on triggered oscilloscope systems.

(8) Lightning frequency spectrum measurements at 60, 100, 175, 300, 500, and 900 MHz. The receivers operate with a bandwidth of 300 kHz over a dynamic range of 60 db.

(9) Balloon measurements of airborne electric fields.

(10) Tower measurements of IR radiation profiles and wind vs height.

(11) A weather satellite receiving station.

Italy

In Rome we visited the high-voltage laboratory of Dr. Carlo Mazetti in the Electrical Engineering Department of the University of Rome, where we discussed lightning research. In Milan we talked about Italian lightning current measurements with Mr. Emilio Garbagnati of the Center for Electrical Research. We also discussed the theoretical modeling of stepped leaders with Dr. Roberto Pignini of Centro Informazione Studi Esperimentali (CISE). Pignini extrapolates data from the French long-spark measurements at Les Renardières, where he worked previously, to lightning. We visited the instrumented tower at Mt. Orso where Garbagnati measures lightning currents. The shunts are carefully calibrated and have a time resolution of about 50 ns. The output of the shunt feeds three simultaneously triggered dual-beam oscilloscopes (Tektronix 7844), which are photographed with still and streak cameras. The trigger threshold is 3 kA and there is a 50-ns delay line. A remote camera about 600 m away is activated by the lightning electric field signal and photographs the lightning. The entire recording station is automatic and has been in operation for over 10 years.

France

At the Centre d'Essais en Vol (CEV) or Flight Test Center in Bretigny, we saw two instrumented aircraft, a Transall and a Meteor NF11, which are used for airborne measurements of lightning fields and currents and of precipitation charging. ONERA and CEV jointly fund the studies but the bulk of the measurements on the Transall are made by CEV. The Transall lightning measurements include:

(1) Currents on front and rear booms to amplitudes of ± 150 kA with a bandwidth of about 3 MHz.

(2) Four field mills to provide charge on the aircraft and atmospheric electric field. A real-time display of the field and its direction is used to vector the plane into high-field regions where the probability that it will be struck is high.

(3) Electric and magnetic fields inside and outside a window on the aircraft surface. Induced voltages on three wires inside the window (one short-circuited, two terminated in 50 ohms). The signals are sampled by four Tektronix transient analyzers with 10-ns resolution. Most signals are recorded on tape by means of two 3-MHz video recorders, two 14-channel 400-kHz tape recorders, and two 10-MHz magnetic tape recorders. The digital records are registered with 1,500 pre-trigger points at 10-ns intervals and 500 post-trigger points at 50 ns. Several additional magnetic field measurements are made on the aircraft surface and transcribed on the 400-kHz tape recorder.

(4) Precipitation charging of a special insulated windshield.

(5) Film and TV camera photographs of the lightning strikes.

(6) Photoelectric measurements of light impulses from the tip and front of the fuselage.

Most analog data are transmitted from the current or field sensors through fiber-optic links that have a dynamic range of 41 db and a bandwidth from 500 Hz to 180 MHz.

The electric field sensor, a Thompson TSM 245E10, has internal integration and a flat frequency response to 150 MHz. The Thompson TSM 245H10 magnetic field sensor is similar to the electric field sensor.

The Meteor aircraft has about 100 measurement channels recorded on magnetic tape to study precipitation charging and the electrostatic environment of the atmosphere. Among the measurements are:

(1) five electric field mills to provide total charge on the aircraft and the atmospheric field environment;

(2) five corona noise measurements at 10 kHz (VLF), 100 to 500 kHz, 20 MHz, 110 MHz (VOR), and 200 MHz (ILS);

(3) aircraft skin current at 40 locations;

(4) 5 to 10 measurements of current on a series of interchangeable dielectric surfaces;

(5) aircraft and engineering parameters such as speed, pressure, temperature, and pilot's comments.

The discussions with Joel Hamelin and B. Djabari at Centre National d'Etudes des Télécommunications (CNET) in Lannion, France, were particularly interesting because the CNET measurements of electric and magnetic fields, on both triggered and natural lightning, are very similar to those being made by the universities of Florida and Arizona. In addition, CNET has measured lightning-induced voltages on overhead communications lines and is developing theory on the subject. Very similar work is currently being done at

the University of Florida. In addition to the electromagnetic measurements, we were shown high-speed films of triggered lightning events and discussed such interesting luminous phenomena as the occurrence of dart leaders at the same time that continuing current was flowing.

During the visit to Electricité de France (EDF) at Les Renardières, we were surprised to learn that despite all the excellent long-spark breakdown studies extending over many years, no one working at Les Renardières has speculated in print about the relationship between long-spark breakdown and lightning. Of course, others (e.g., Pignini in Italy) have been doing this in many places throughout the world.

At ONERA we saw the following laboratory experiments:

- (1) optical image converter study of the formation of a spark along a dielectric surface;
- (2) measurements of the electric and magnetic fields outside and within a cylinder containing apertures when a current pulse of 40-ns rise-time is passed through the cylinder;
- (3) scale-model studies of the Transall aircraft to allow calibration of the various airborne electric and magnetic field sensors;
- (4) instrumentation to measure aircraft surface resistivity beneath an insulation layer of paint, plastic, etc.;
- (5) spray electrification apparatus.

Dr. E. Philip Erider

University of Arizona

MATERIAL SCIENCES

METALLURGICAL RESEARCH AT THE ROYAL AIRCRAFT ESTABLISHMENT

The Materials Research Department at the Royal Aircraft Establishment (RAE), Farnborough, is headed by Dr. D.K. Thomas. The department consists of 90 professionals and has primary responsibility for aircraft structural materials research for the UK Ministry of Defence. Its broad research program is concerned with metals, non-metals, polymers, composites, and the physics and chemistry of materials. Dr. C.A. Stubbington heads the Metals Division, which I visited. The division has 20 professionals in 5 groups: Aluminium Alloys and Failure

Analysis, Engineering Properties, Manufacturing Technology, Titanium Alloys, Corrosion and Protection.

The principal activities of the Aluminium Alloys and Failure Analysis Group, as its name indicates, involve failure analysis, primarily nonroutine fractographic investigations, and research and development of aluminum alloys. Much of the aluminum alloy research is concerned with alloys based on the aluminum-lithium system. In addition to Dr. D. Forsythe, the group head, C. Peel and B. Evans are actively engaged in research on this alloy system. The group is enthusiastic about the potential of such alloys for future aircraft applications and also feels that it soon might be possible to substitute these alloys directly in selected components for which 2000 or 7000 series alloys are now specified. Such direct substitution would result in significant weight savings and would be cost effective.

Forsythe and his group have been investigating aluminum-lithium alloys for a number of years. They initially investigated the Russian alloy Al-4Mg-2.3 Li that stimulated activity in this system. They have since studied about 20 alloys, binaries, ternaries, and quaternaries, such as Al-Mg-Cu-Li, in an attempt to optimize properties. Because the compositions are patentable, they could only discuss them in general terms, but they are encouraged by the properties they have been able to obtain in sheet form. In particular, they feel that they have been able to obtain improved fracture toughness values and quoted values like 70-80 MPa(m)^{1/2} for material with a proof stress at 0.2% of 380 MPa. Their goal for fracture toughness values is 100 MPa(m)^{1/2}, but they have not achieved this yet. Crack-growth rates at low K values are said to be better than those observed in comparable commercial aluminum alloys. Formability in the quenched condition is very good and tensile ductility values of 6 to 10% are typical. Up to now they have only been able to achieve acceptable properties in sheet sections; to produce such properties in thick-section plate would require aging times too long for commercial practice. They feel that this is because they are not getting enough homogenization during the breakdown from ingot to plate due to the small (laboratory) size of their starting ingots, 25 to 30 kg. They expect that when they scale up to produce commercial-sized starting ingots, work currently being carried out by British Aluminium (BACO), they will be able to produce 4-in plate with properties such as are obtainable now in sheet. It appears that their expectations may well be realized, for at the time of my visit they received

word from BACO of the successful rolling of the first commercial-sized ingot with an RAE optimized alloy composition.

In addition to their alloy development work, they are carrying out a full range of tests for alloy characterization, forging trials, fatigue tests, and marine corrosion-stress corrosion-exfoliation tests. Besides conducting their own research, they sponsor research on these alloys at several UK universities such as the University of Nottingham and Imperial College. Of particular interest at these institutions are studies to determine if slip is generalized or planar (a subject of some controversy), factors affecting deformation mode, and studies of the effect of processing schedules on microstructure and concomitant properties.

Dr. N. Wilson is in charge of the Engineering Properties of Materials Section. At one time the group did a good deal of research on the creep of Al alloys in support of the Concorde and the creep of composite materials, but this area is not so active today. Now the section is concerned primarily with the fatigue and fracture of a range of aircraft materials. One interesting research program is related to the use of carbon fiber patches to prevent or retard fatigue-crack growth in Al sheet components. In the research they grow a fatigue crack in aluminum alloy panels to a specific length while measuring crack growth rates using a dc potential drop method. They then stop the fatigue test and adhesively bond a carbon fiber mat with orthogonal weave to one side of the plate over the crack tip. After curing the bond they continue the fatigue test. In tests on 7475 clad sheet they have found that crack-growth rates can be lowered greatly and, in some cases, growth is stopped completely. At the present time they are studying those aspects of the patching technique that are important in effecting reduced crack-growth rates. Right now, it appears that the important factors are the type of adhesive and the thickness of the adhesive layer and that mat shape and geometry are of secondary importance. As support for the work, they are sponsoring theoretical modeling research on the patching process at the University of Southampton. They feel that the patching process may offer a cost-effective, technically satisfactory approach for extending the life of fatigue-sensitive components or for building up underdesigned parts. But they admit that further studies, such as those involving long-term bond stability, moisture sensitivity, and the effect of plate bending,

must be made before the full potential of the process is known.

Another program in this group is concerned with how the preexposure of aluminum alloys to marine atmospheres affects their strength in subsequent fatigue tests. An example of this work is their study of 7010 Al alloy exposed to salt-fog atmospheres. They found that the fatigue strength of the alloy was reduced to 200 MPa when fatigue testing was conducted in a salt-fog atmosphere as compared with a value of 270 MPa they observed when the testing was conducted in laboratory air. But perhaps more important was their finding that the same reduction could be produced by simply keeping the specimen in the salt-fog atmosphere for a period of 8 h before fatigue testing. They feel that the reduction is caused by pits that occur during preexposure and act as fatigue crack initiation sites.

Other research in the group includes an AGARD-sanctioned corrosion fatigue program in collaboration with several US laboratories and a study of the role of crystallographic texturing and grinding damage in Ti alloys.

The Manufacturing Technology Section is headed by P. Partridge. Primary interests in this group are superplastic deformation and diffusion bonding of Ti and Al alloys. In research with Ti-6Al-4V, they are determining the effect of crystallographic texture on the superplastic deformation process. They have found that strongly textured material deforms superplastically in an anisotropic manner until a strain of about 200% is reached; at strains greater than this the alloy behaves isotropically. They are interested in determining why this behavior occurs and, in particular, how this affects the subsequent properties of the alloy, especially crack growth rates and fracture toughness. In aluminum research they have been investigating the superplastic deformation of 7010 and 7475 alloy. With 7010 they can achieve strains of the order of 350%, but the strain rate they have to use to do this is 10^{-4} s^{-1} , which is too slow for commercial application. When they try to deform the alloy using strain rates of 10^{-3} s^{-1} , which would be commercially acceptable, they observe grain boundary cavitation at strains of the order of 80%. In addition to studying the cavitation process, they are trying to devise a test method that would be sensitive enough to detect grain boundary cavitation and simple enough to be used commercially. At this time, both reduction in area measurements, which appear to be sensitive to cavities with diameters in the $0.5\text{-}\mu\text{m}$ range, and high precision density measurements seem to be viable methods. In the

case of 7475 alloy, they are beginning to investigate its superplastic behavior using thermomechanically processed starting material.

R. Gardner heads the Titanium Alloys Section. The major interest of this group is fatigue of Ti alloys. Gardner and his researchers are engaged in a study of the high strength alloy IMI 550 (Ti-4Al-4Mo-2Sn-0.5Si) to determine the effect of microstructure on fatigue-crack growth rates. They are testing the alloy in structures containing 50, 70, or 100% transformed beta. Fatigue testing involves the use of a spectrum-loading regime called Falstaff. This is a Dutch-German spectrum that is a composite of wing loadings experienced by several different types of fighter aircraft during a variety of missions. They are comparing crack-growth rates obtained using this type of loading with rates obtained using simple sinusoidal loading. Initially they were using compact tension specimens, but because they were experiencing crack closure effects they have shifted to single-edge tension specimens. In preliminary results, increasing the beta content of the alloy appears to be an effective way of reducing crack-growth rates.

In another program they have been studying fatigue crack growth in welded Ti-6Al-4V in the following conditions: as welded, stress relieved, and solution treated plus aged. They observed that crack growth rates in the as-welded condition were much slower than when the weld had been stress relieved or solution treated plus aged. They have correlated this behavior with the large residual stresses found in the alloy as welded, some of which approach the alloy yield strength.

Dr. Thomas described the research going on in the Corrosion and Protection Section, which I did not have the opportunity to visit. This group is conducting research aimed at characterizing the corrosion behavior (stress corrosion, exfoliation, crevice corrosion, etc.) of newer alloys such as 7010. Other activities of the group include the search for corrosion inhibitors to replace the toxic but effective chromates—a problem of interest to corrosion groups everywhere, and the search for plating substitutes for cadmium.

Philip A. Clarkin

ONR London

SOME PROCESSING RESEARCH AT IMPERIAL COLLEGE

Research programs concerning processes conventionally used to deform and shape metals, such as rolling and extrusion, have been in existence for many years at the Imperial College of Science and Technology, London. The purpose of the research is to determine the structure and substructure developed under various processing conditions, the mechanisms by which the structures are formed, and the influence of the structure on the subsequent mechanical properties of the product. The ultimate practical goal, of course, is to make it possible to prescribe a processing schedule to follow in order to achieve specific properties. Dr. T. Sheppard, senior lecturer in the Department of Metallurgy and Materials Science, and his coworkers have been active contributors to the program.

Although Sheppard recently initiated programs on the processing of steels and titanium alloys, for the most part his research has dealt with the rolling and extrusion of aluminum alloys in both bulk and powder form. A principal part of the research has been aimed at the development of constitutive relationships for metal deformation processes at elevated temperatures. This has resulted in an equation of the form where α , A , and n are constants, σ is the stress, and Z is a temperature-compensated strain rate.

$$\sigma = \frac{1}{\alpha} \ln \left\{ \left(\frac{Z}{A} \right)^{1/n} + \left[\left(\frac{Z}{A} \right)^{2/n} + 1 \right]^{1/2} \right\}$$

Experimental testing with two aluminum alloys showed that the constants of the equation could be evaluated by torsion testing as long as temperature rises in the test specimens due to twisting were taken into account. To do this, a three-dimensional finite difference model that allows one to obtain an average temperature rise during the test was developed. The work was reported in *Metals Technology* June 1979, pp. 215-229, and research to refine the relationships and to extend the treatment to other alloy systems continues.

Sheppard's group has also conducted a number of investigations to ascertain the dislocation dynamics associated with deformation processes, particularly hot extrusion. The dynamics of the process were inferred from a careful analysis of the structure and substructure of the deformed product. Much of the research

has dealt with hot extrusion of high-purity Al-Mg alloys and the commercial equivalent, alloy 5456. In its initial research on the high purity alloy, the group found that deformation occurred solely by a process of dynamic recovery. This was contrary to the findings of earlier investigators who concluded on the basis of hot compression tests that dynamic recrystallization was also taking place. These investigators reasoned that recrystallization was a result of a lowering of the alloy stacking fault energy (SFE) by the Mg additions. Sheppard is skeptical of this interpretation because he feels that the SFE cannot be changed by alloying with Mg. In alloy 5456, on the other hand, Sheppard has found evidence for both dynamic recovery and dynamic recrystallization. The difference in the behavior of the two alloys, he feels, is due to the smaller grain size and the greater amount of precipitate and second-phase particles in the commercial alloy rather than to any change in SFE.

A correlation of product properties with processing parameters is, of course, a primary aim of Sheppard's research, but the correlation has not proved to be straightforward in many cases. In 5456 alloy, for example, it was found that while the duplex deformation processes resulted in a product with enhanced mechanical properties, the properties could not be correlated with the structure or the processing parameters. Apparently this was due to the complex duplex structure of the product, a mixture of fine recrystallized grains within a subgrain matrix.

An important feature of the work of Sheppard's group has been the development of limit diagrams for the extrusion of aluminum alloys. The diagrams (Fig. 1) indicate the conditions of extrusion ratio and temperature that will result

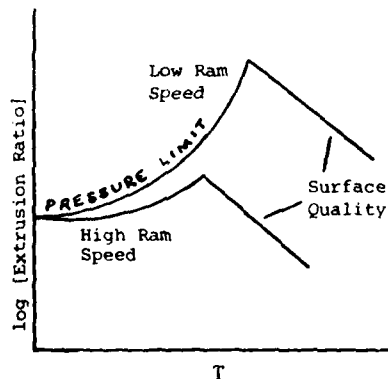


Figure 1

in satisfactory extrusions both from the mechanical standpoint of the ability to extrude (pressure limit), and from the cosmetic standpoint of freedom from surface cracks, etc. (surface quality). Although the diagrams cannot be constructed *a priori*, much research has been conducted in an attempt to make them less empirical by including temperature-compensated strain-rate factors. This is especially true in the determination of the pressure limit boundaries.

From a practical standpoint, Sheppard's group is seeking to determine which hot processing parameters can be altered to control problems such as "earring" in Al-Mg alloys and "roping" in ferritic stainless steels. Earring is the scalloped effect one can get at the top of a deep-drawn object as a result of nonhomogeneous deformation of the sheet metal blank. Sheppard feels that the crystallographic texture developed during cold rolling operations may not be the sole controlling factor in this type of fault as is commonly supposed, but that the total strain and substructure developed in the hot deformation stages play important roles too. Roping is the term given to the ropelike appearance of bands of large recrystallized grains across the surface of a part. A study of this non-uniformity of recrystallization in ferritic stainless steels has just started. Here again, the aim is to relate this phenomenon to processing parameters.

Recently initiated research is aimed at improving the fracture toughness of Al-Mg-Li alloys (this is being sponsored by the British Aluminium Company Ltd. and will probably involve thermomechanical processing) and developing structure-property relationships and constitutive relationships for 7075, 7050 alloy and titanium alloys, starting with Ti-6Al-4V and proceeding to beta alloys. In addition to these, the group is studying the effect of the substructure formed during hot processing of austenitic stainless steels on subsequent martensitic transformations in the alloys during service.

The simultaneous consolidation and extrusion of metal powders has been of particular interest to Sheppard, and he is carrying out a number of programs to study the process. As a result of the research, it has been determined that, in the case of Al alloys, the process is thermally activated with an activation energy close to that of self diffusion of aluminum, 156.5 kJ/mol. In view of this, he surmises that either dislocation climb or the migration of jogged screw dislocations is the rate controlling process. He also has found that the process is far less dependent on strain rate than

the conventional process using cast materials. His current research in this area consists of studies of the extrusion of aluminum powders with reinforcing additions such as glasses and fibers and extrusions of rapidly solidified powders. Research on glass-reinforced aluminum has not produced composite alloys with significantly enhanced mechanical properties, but extrusions made with Al containing 5 to 10 percent of Kevlar fibers appear promising. Based on the results of six billets, the modulus looks as though it may be increased by about 30 percent, but much more work needs to be done to see if the effect is real.

Sheppard feels that the extrusion of rapidly solidified powders could have interesting results. He reasons that, because one often can get much higher alloying contents in rapidly solidified materials, the dislocation dynamics during deformation may be changed with concomitant changes in substructure and mechanical properties. He is currently experimenting with rapidly solidified aluminum alloy powders of the 7000 and 5000 series supplied by ALCOA. In research done to date, he has extruded 7050 powders to compare the properties of the alloy with those of cast and rolled material, and he has extruded Al-10 Mg powders, an alloy that cannot normally be extruded in cast form. In these cases, he found that dynamic recrystallization played a major role in the deformation process as opposed to the dynamic recovery processes usually encountered.

Dr. W.M. Steen, a lecturer in the Department of Metallurgy and Materials Sciences, heads a group of 12 doing research on laser processing of materials: welding, cutting, surface hardening, surface alloying, and cladding. Seven of the group are doctoral candidates and three are postdoctoral researchers.

For several years Steen has pioneered in arc-augmented laser processing whereby an electric arc is used in conjunction with a laser beam as shown schematically in Fig. 2. The configuration with the arc on the same side of the substrate as the laser is found to be most efficient for welding purposes, and the arc on the opposite side from the laser beam is the better cutting configuration.

In arc-augmented processes it has been found that, because the substrate hot spot or the plasma generated by the laser has a greater electron density than the surrounding regions of the substrate and offers the path of least resistance for the nearby arc, the arc will move to the same focus as the laser spot, sometimes traveling several millimeters when the laser is turned on.

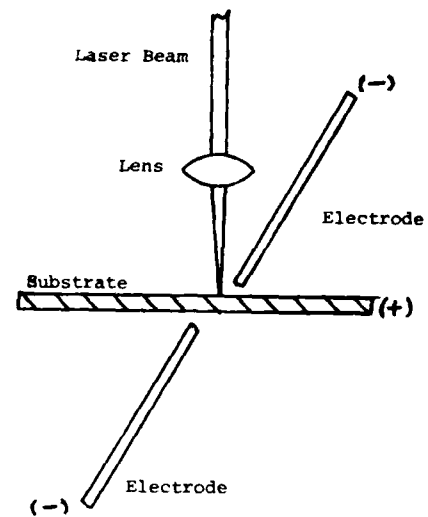


Figure 2

In addition, the laser plasma causes the arc diameter to contract and part of the arc is conducted down the keyhole produced in the substrate by the laser. As a result of this cooperative action, much more energy is deposited in the laser spot than could be deposited by the laser alone. So by using relatively inexpensive arc welding equipment, one gets the effect of using a much more powerful and more expensive laser.

With arc-augmentation, then, penetration is greater or speed of welding or cutting can be increased. For thin steel sheet (0.2 mm), for example, Steen has shown that welding speed can be increased by a factor of four. Unfortunately, such speed increases are not possible with thicker material because the weld quality deteriorates. With 8-mm Ti sheet, however, weld quality was maintained while speed was doubled using arc currents of only 50 A. In general, Steen has determined that arc-augmented welding is useful up to about 100 A (1-kW power augmentation).

For cutting, it was found that cleaner cuts were obtained with the arc on the opposite side of the substrate from the laser and its coaxial oxygen jet. Using augmented power of about 2 kW and arc currents under 300 A, cutting speed and penetration could be markedly improved while maintaining the quality of the kerf. For instance, the speed of cutting 3-mm steel sheet could be almost doubled using a 200 A arc.

In addition to laser welding and cutting research, Steen has a number of other research tasks concerned with surface

modifications using lasers. These include surface hardening of steels, surface alloying, laser glazing of Ti and Ni base alloys, and laser cladding. Much of the research is of an applied nature and involves trials for industrial sponsors who are experiencing corrosion and wear problems. Laser cladding is of particular interest to Steen, and he is in the process of studying arc augmentation of the laser cladding process. To do his research, Steen has two axial-flow, shock-stabilized CO₂ lasers, each of 2 kW output, that can be focused to a spot size of 0.2 to 0.4-mm diameter. These can be operated in the pulsed or CW mode and the beams can be combined at a series of work stations to give 4 kW of power.

Philip A. Clarkin

ONR London

PHYSICS

MAGNET MANUFACTURING IN SUSSEX

Given the present state of the economy of the UK, any business that has shown continual growth over the last 5 years is unusual. Tesla Engineering Ltd., in Storrington, Sussex, is a company whose growth is more remarkable in view of the fact that it does not advertise. Currently, Tesla has an annual turnover of more than 1 million pounds. As the name implies the company is involved principally in the manufacture of large volume magnets and coils for use in nuclear and medical research by large institutes.

Founded in 1972 by the present managing director, Mr. John A. Wheatley and the present technical director, Mr. David R. Willis, the company now employs 50 people. Except for the directors and several senior design engineers all the employees are young people. Many were recruited directly from school and trained by Tesla.

According to Willis, the magnetics market, where Tesla is particularly active, is consistently growing at the rate of 2.5 % each year, with sharp peaks of demand approximately every 5 years when nuclear accelerators come on line. Tesla is aiming at the average growth part of the market because the company is not configured to meet the exceptional demand arising in the peak times. This rather special market is shared by a

small number of companies throughout Europe. There are approximately 12 such companies, most larger than Tesla. In practice there is little competition because each supplier is normally specialized in a particular segment of production and orders are allotted on the basis of company reputation rather than price.

In addition to large and small solenoids, Tesla manufactures more complex magnets, especially quadrupoles and sextipoles. Coils of these types for use in accelerators have been manufactured for Harwell Laboratory, Daresbury Laboratory, the Rutherford Laboratory, Culham Laboratory, the Max-Planck Institutes in Berlin and Garching, and CERN. Other large scale projects are a specially cooled septum coil for beam extraction from an accelerator, coils for a very large mass spectrometer designed to separate isotopes in weighable amounts, and coils for use in nuclear magnetic resonance (NMR) tomography of the body trunk. On a more modest scale, a small Stern-Gerlach magnet was constructed recently for instructional laboratory use in a British university.

At the time of my visit, pancake coils for the bending magnets of the synchrotron radiation source (SRS) at the Rutherford Laboratory were being wound. The large 5 m by 70 cm coils were being constructed of square cross-section, hollow copper tubing approximately 5 mm on a side. The tubing, called a filament, which comprises the windings is wrapped with insulating material before being wound. As the demand rate for the filament is not constant when a non-circular coil is wound, the wrapping machine is servo controlled so as to provide constant wrapping rate and therefore constant insulation overlap. This process also insures that the wrapped filaments are of constant thickness.

The pancake coils under construction were of a roughly distorted oval shape so that one of the long sides was concave. To form this side, winding was temporarily halted after the filament had been laid across what would become the concave side of the form. Then hydraulic pistons operating a mating form were used to force the concave side of the pancake into the desired shape. The completed pancakes, each of which weighed about a ton, were assembled in units of three into subcoils which were further wrapped with insulation. Two subcoils were assembled into the final coil and wrapped with more insulation and heat shrinking tape. The completely wrapped coil was then placed in a form-fitting aluminum mold and impregnated with epoxy resin in a heated vacuum chamber.

In addition to the coil winding and epoxy potting facilities, the company also has a large machine shop in which the coil winding machines, magnet yokes, and laminations are manufactured. At the time of my visit a partial production run of 20 quadrupole magnets was being undertaken. The magnets were manufactured entirely on the premises.

Tesla has another facility for reconditioning used electromagnets. The magnets often are radioactive after being used in an accelerator, so adequate precautions are taken to protect the work force. The facility is inspected and licensed by the British government. A related product is lead glass windows for viewing radioactive cells.

I was also shown the parts for a portable hand-held explosives monitor. This sensitive device detects explosives by the backscattering of neutrons. It is designed for use by security personnel at airports and other points of entry to detect smuggled explosives.

Willis pointed out that the company is not fitted for, or interested in, large-scale production runs. Instead, it concentrates on the manufacture of small numbers of devices on the leading edge of technology. By following this precept Tesla has given new life to the old adage about the better mousetrap.

John R. Neighbours

ONR London

SOLID STATE PHYSICS IN STOCKHOLM

University of Stockholm

The Institute of Physics of the University of Stockholm is near the outskirts of Stockholm in a relatively old building. Most of the rest of the university has moved further outside the city to new buildings, but the recent downturn in the Swedish economy prevented the natural sciences section from being moved to the new location. The institute covers six general fields with a professor in each: field theory, quantum chemistry, high energy physics, nuclear physics, molecular physics, and electronics. None of these is specifically solid state physics, but T. Gerholm, professor of nuclear physics, showed me the projects in which the techniques of nuclear physics were applied to the study of condensed matter.

The solid state physics work is concerned principally with applications of the Mössbauer effect and the laboratories contain several different

Mössbauer apparatus. A principal instrument is an electrostatic spectrometer designed and built in the laboratory (*Nucl. Inst. and Methods* 154 401 [1978]). The instrument is of the cylindrical mirror type used especially for energy differential conversion electron Mössbauer spectroscopy experiments. Not only are the electrons detected, but their energies, and therefore their depth distribution, are determined. Called depth selective conversion electron Mössbauer spectroscopy (DSCEMS), the method is claimed to have the power of resolving absorber structure in a detail fundamentally unobtainable in conventional Mössbauer spectroscopy.

Analysis of the results requires that the transport of the K and L conversion electrons as well as the Auger electrons and the resonant photoelectrically produced electrons be taken into account. D. Liljequist, an associate professor at the institute, has published a number of papers on the analysis of DSCEMS; the most recent is concerned with software and interactive methods for interpretation and quantitative analysis of the data (*Nucl. Inst. and Meth.* 177 495 [1980]). In another recent paper, Liljequist has published improved calculations for naturally occurring ^{57}Fe isotope abundances for Mössbauer spectroscopy using integral detectors (*Nucl. Inst. and Methods* 179 617 [1981]). Liljequist has found good agreement with experiments for stainless steel covered with a thickness of Fe up to 3,000 Å and less good agreement for magnetite in up to 5,000-Å thick layers covering an Fe substrate.

Associate professor J. Blomquist is interested in the state of Fe in compounds as influenced by the local environment. Recently he published (*Journ. Elect. Spect. and Related Phenomena* 22 195 [1981]) a study of various configurations of Fe ions ranging from $3d^3 4s^1 4p^1$ to $3d^9$ (6F to 2D states) in which the radial integrals of r^{-1} and r^{-3} were calculated using nonrelativistic Hartree-Fock wave functions. The results show that the distributions of charge of different subshells having the same principal quantum number are quite different and that the variation with molecular environment is nearly the same for the inner shell binding energies and the potential at the nucleus.

Blomquist, in association with personnel from the Chemistry Department at the University of Lund, has been applying Mössbauer spectroscopy to the study of the catalyst iron phthalocyanines (FePc) (*Inorgan. Chim. Acta* 53 L39 [1981] and *J. Inorganic Nucl. Chem.* 10 2287 [1981]). The main purpose of the study was to investigate the charge distribution of the

Fe atom in a number of different phthalocyanine samples and to gain information for comparing the results obtained by Mössbauer spectroscopy with those realized from electrochemical measurements. In as yet unpublished work using polymeric FePc enriched in ^{57}Fe , the Mössbauer spectra were characterized by the increase of a signal corresponding to oxidized Fe as the catalytic activity decreased. During the first 100 h the oxygen reduction electrodes were in operation, a correlation was seen between the amount of Fe dissolved in the electrolyte and the electrode potential, and this suggested that Fe(II) is oxidized to Fe(III), which is dissolved into the electrolyte.

Royal Institute of Technology

The Royal Institute of Technology, like the Institute of Physics, is on the outskirts of Stockholm. The Department of Solid State Physics, under the direction of Prof. H. U. Åström, is part of a department that also includes atomic physics, optics, semiconductors, applied physics, photography, and remote sensing. Åström long has been interested in phase transitions especially in magnetic systems. He has been particularly interested in pure chromium (*J. Phys. F: Metal Phys.*, 5 1966 [1975] and *Phys. Rev. B*, 18 [1978]) and dilute substitutional chromium alloys CrFe, CrSi (*Journ. Phys.* 39 C6-785 [1975]). Measurements of the magnetic susceptibility, the lattice heat capacity, the electrical resistivity, and the thermal conductivity show that the phase transitions in these materials are of both first and second order. Recently reported measurements (*Journ. Magnetism and Magnetic Materials* 15-18 283 [1980]) of the magnetic susceptibility and electrical resistivity of a CrSi alloy doped with V show that the presence of V has a drastic influence on the para-to-commensurate (P-C) antiferromagnetic transition. Addition of one-tenth atom percent of V depresses the transition from 232°K to 130°K with the sharpness of the transition unchanged. Addition of one-half atomic percent of V completely suppresses the transition. This remarkable result implies that the influence of V is of quite long-range character and that the spin density wave appears to maintain its commensurate structure even though the electron atom ratio is slightly reduced by the addition of V. The results are consistent with those found from pressure studies.

Along with G. Benediktsson, L. Hedman, and K. V. Rao (Univ. of Illinois), Åström has recently completed latent heat and magnetic susceptibility studies

on CrFe and CrSi alloys. These are the only two binary chromium alloys that exhibit an abrupt change in their physical properties as a result of the P-C spin density wave type of antiferromagnetic transition. The results show a broadening of the initial weak first-order transition in pure Cr, an effect ascribed to added impurities or strains. The magnitude of the latent heat for the P-C transitions is considerably greater than those for the para-to-incommensurate (P-I) transitions, and the observed latent heats correlate well with the pressure dependence of the Néel temperature as calculated from the Clapeyron equation. These results have been submitted for publication to the *Journal of Physics F*.

Below the antiferromagnetic transition temperature in Cr ($T_N = 310^\circ\text{K}$) the spin density waves are characterized by polarizations of the spins. Between the Néel temperature, T_N , and the spin-flip temperature, T_{sf} , the spins are characterized by transverse polarization; below T_{sf} the spins are polarized longitudinally. The transition at T_{sf} is of first order and the recent measurements by Benediktsson and Åström determine that $T_{sf} = 123.2^\circ\text{K}$. The spin-flip transition is a rather weak one so that the observed energy changes around T_{sf} are measured in microwatts per mole and therefore there is a relatively large imprecision in determining the value of the latent heat. However, the results of a differential calorimeter technique give a value of 0.04 ± 0.02 J/mole. The authors point out that there is no microscopic theory that enables the calculation of this latent heat but that a relatively good estimate can be obtained from the Clapeyron equation (0.02 ± 0.01 J/mole). The latter value is considered to be in reasonable agreement with the experimental results, which are to be published in *Physica Scripta*.

Last year O. Källback retired from teaching. He continues to be active in research and recently collaborated with S. G. Humble, who is occupying a 1-year research position. The two have made high precision measurements of the electrical resistivity ρ of Ni through the Curie temperature ($T_C = 631^\circ\text{K}$). The transition from the paramagnetic to the ferromagnetic state is less singular in the resistivity than in the heat capacity, because it is the temperature coefficient of resistivity $d\rho/dT$ that shows a cusp-like behavior. At the Curie temperature the resistivity shows only a kink.

In the experiment, the sample Ni wire and the wire platinum resistance thermometer were placed in intimate contact with each other inside a furnace that

has a stability of better than 1mK. Resistivity measurements were taken at 0.2°K intervals allowing 1 h between measurements to achieve thermal equilibrium. Källback and Humble point out that these resistivity measurements refer to a quasi-stationary state rather than a changing one as for heat capacity measurements. A complete run through the entire temperature range covered by the Curie temperature (623.8 to 637.9°K) took approximately 54 h. Resistance and temperature were measured using an 8-digit bridge. The experimenters have fitted their results near the singular region with a function of the form $R(T) = At^{1-\alpha}(1+Dt^2)$ where $t = |(T/T_c) - 1|$ is the absolute value of the reduced temperature and α is the critical exponent. A and D are constants whose values turn out to be different on the high and low side of the transition. The results are $\alpha = 0.0095$; $A/A' = 1.52$, and $D/D' = -0.8$, where the primes refer to the lower temperature region. The authors have also applied their method to the results of resistivity and heat capacity experiments on other ferromagnets. They find in all cases that the experimental values of α are in reasonable agreement and somewhat lower than the theoretical prediction ($\alpha = 0.115$). Similarly the experimentally determined absolute values of the ratios A/A' are in agreement and differ from the theoretical prediction ($A/A' = 1.24$). Rounding of the experimental data was observed near T_c , an effect that was attributed to the fact that the relaxation time of the system becomes very long. A full account is to be published in *Physical Review B*.

Källback and Humble currently are doing the same type of resistance measurements on Fe, and they expect to obtain approximately the same results they obtained for Ni. When the experiment is finished they plan to measure the resistance of dilute NiCu alloys to determine the dependence of α on the concentration of Cu.

John R. Neighbours

ONR London

NEWS and NOTES

BRITISH STROBE-LIGHT GUN

A new strobe flasher, termed the Valkyrie, has been developed by a UK manufacturer. Resembling a large hair dryer and powered by a 12-volt battery, it delivers extremely bright flashes and is designed for use in crowd control and other emergency situations, such as during a bank robbery. The flicker rate is about 5/s.

There are few published data on the effects of intense strobe light on humans, though occasional uses have been reported as far back as the Suez Crisis of 1956. At frequencies in the 13 to 16 Hz range, limited photic driving can occur in some individuals; that is, EEG frequencies can be "driven" or caused to follow the frequency of a flashing stimulus within a certain range. Also, in a very few people, epileptiform reactions may occur. British police laboratories have, until very recently, refused to adopt such devices because of this risk factor. The manufacturer's own tests indicated that the gun could cause nausea and dizziness, but according to British neurological consultants, there are no long-term effects from strobing. Greater London Council, the local county-like authority for the London area, has set an upper frequency limit of 8 Hz for flashing lights in discotheques.

To add to the momentary distraction, the Valkyrie also emits a loud piercing scream. The sound level of this scream is reportedly on the order of 120 to 130 db a few feet from the gun. The scream frequency swoops down, then back up, ends in a grating squawk, and then repeats every few seconds.

The idea of the whole system, of course, is to provide some strong disconcerting stimuli that will engage a human subject for a few seconds, until other action can be taken. Further technical development, and further legal challenges too, can be expected in this area. At present, UK police authorities say, the Valkyrie is probably illegal for use in Britain. The manufacturer reports inquiries from many other countries, principally Middle Eastern ones.

Nicholas A. Bond, Jr.

ONR London

GROWING UP IN ULSTER

Much of the news from Northern Ireland reports on the violence there. Body-count totals are regularly published, sometimes in the headlines. On British evening TV news, it is quite usual to see the funeral of the latest terrorist victim; after a brief look at the procession and the bereaved family at graveside, there is often a background shot showing the spot where the bomb went off, or the bridge where the victim was when he or she was ambushed. If a house, car, or bridge has been burned or demolished, the wrecked item may be displayed. Later in the news, Ulster politicians and religious figures may appear and offer either placatory or inflammatory comments on the latest atrocity. Informal paramilitary organizations may be shown as they drill their members for future conflict.

It doesn't sound like a good place to raise a child. In an atmosphere saturated with real danger and bitter religious strife, one might expect children to be radically affected. But recent research by Elizabeth McWhirter, Karen Trew, and Mary McIvor (Queens University, Belfast) is rather encouraging. Not only is Ulster actually less violent than it seems (the average citizen of Detroit or Chicago is far more likely to be mugged or murdered), but the children's self images and perceptions of the world are surprisingly normal. The researcher's conclusion is that "...in our belief the consequences of the conflict are not so pervasive or injurious as previous research and much speculation suggests."

Trew asked 609 Catholic children (ages 9 to 11) from urban and rural areas to write down 20 things, in answer to the question "What are you?" She wanted to see how the children identified themselves. When the responses were coded into 91 categories, most of them had to do with sex, personal qualities, friendship, physical features, and family. There was relatively little mention of religion. "They could have been pen portraits of children of a similar age from England, Canada, or any similar Western country."

McIvor tested both Protestant and Catholic children, with some subjects from peaceful areas and some from districts in the heart of the troubles. She presented them with an ambiguous story situation and coded the themes. Fifty-three percent of those children who lived in the most troubled areas made no mention of the violence when they wrote about their lives. The

researcher's interpretation is that children are not overwhelmed by the Ulster situation, even when they live in a "hot" district, although their perceptions of Belfast as a violent place are quite realistic.

McWhirter asked over 500 children to write short definitions and essays in violence; some were written during Bobby Sand's hunger strike last spring, an especially tense time. Two-thirds of the children condemned violence; only five percent referred to Catholics and Protestants being violent to each other. Respondents from dangerous areas did mention such acts as stoning, rioting, and vandalism more frequently; but even for this group only 30 percent of the essays mentioned such acts. From all three studies, it appears that the feeling of violence is not all pervasive, and that much of life and much of child development goes on in a reasonably normal fashion. The results remind one of studies on European civilians who experienced massive bombings during World War II. Those studies often reported surprisingly small psychological effects of the very real dangers.

Nicholas A. Bond, Jr.

ONR London

HEARNE'S DREAM MACHINE

There are dreams, and then there are "lucid" dreams. In a lucid dream, the subject is aware that he or she is dreaming and that certain aspects of the dream can be "willed" or controlled. According to a few individuals who have lucid dreams frequently, there is a sense of great detail, and perhaps interaction with the people and objects in the dreamed environment. Some habitual lucid dreamers say that they can "test" their state of consciousness, by attempting to levitate, to move through walls, or to cause people and objects in the dream to vanish or multiply. While all this is happening, the dreamer knows perfectly well that the instant state is not real, even though the imagery may provoke intense emotional responses.

When people have ordinary dreams, they usually move the closed eyes rapidly; in fact, bursts of intense electrooculogram (EOG) activity are distinctive indicators of Rapid Eye Movement (REM) dreaming. How could a sleeping person indicate that he was in a lucid-dreaming state? Keith Hearne, a psychologist working at Hull University (UK), found a subject who had often experienced lucid dreams in the

sleep laboratory there, and instructed him to make a series of left-right eye movements when the lucidity state was achieved. Over a period of 45 nights, the subject had 8 lucid dreams, and the EEG, EOG, and muscular activity (EMG) records for these times were compared with 8 "control" nights. For the subject, lucidity occurred after a period of REM activity lasting an average of 22 s. Lucid dreams themselves lasted from 1 to 6 mins and usually occurred early in the morning. Most surprising of all was the subject's ability to signal, by means of the left-right eye movements, that he was in the lucid state. In some cases, Hearne was able to correlate eye movement signals given by the subject to remembered content of the lucid dream. When the subject was asked to make four eye movements when a "flying" sequence began and five movements when it ended, the electrical recordings corresponded closely to the story of the dream which the subject furnished upon awakening. There was also some evidence that lucid dreamers can reason and remember fairly well, and can act on special instructions given just before going to sleep.

Although all the features made the lucid dream an interesting phenomenon, it was a very elusive one; waiting around for 45 nights to record 8 dreams was a rather inefficient data-collection scheme. Hearne has therefore been trying to induce the lucid state. At the moment, he finds that mild electric shocks to the skin of the wrist work fairly well. Before going to sleep, subjects are told that the mild shock is to ask them whether they are dreaming; if they are dreaming and are lucid, then they are to signal this state by making a few left-right ocular movements. Eight out of 12 new subjects reported lucidity, when run for one night only. Hearne's "dream machine" is a briefcase-size device that detects the REM sleep state in a subject and then delivers the wrist shocks that may facilitate lucidity. If the lucid state can indeed be elicited reliably, there are many potential research queries and applications. Public demonstrations of the machine, on TV shows and during journalistic interviews, are occasionally successful. Sleep laboratories around the world can be expected to replicate some of Hearne's studies, and perhaps to extend his physiological analyses of lucid states in susceptible people.

Nicholas A. Bond, Jr.

ONR London

WAVE AND TIDAL ENERGY

An international symposium sponsored by the British Hydrodynamics Research Association (BHRA) was held at St. John's College, Cambridge, England, from 23 to 25 September 1981. It was attended by some 200 persons, who were mostly from industry rather than academia.

Efforts to harness tidal energy are ahead of similar attempts to utilize wave energy and show more promise of early fruition. In fact, the French have had a tidal power plant in operation for 15 years. In the UK, the Severn Estuary is under serious study to take advantage of its large tidal base, but with notable concern for the environmental impact of a tidal power system.

There are several prime contenders for wave energy machines, but a number of problems still remain to be solved, including economical means of anchoring them in place for long periods of time and safe, efficient means of transmitting generated power ashore. A substantial fraction of the UK Department of Energy funding is dedicated to wave energy studies with the objective of selecting those schemes that are economically suitable for large-scale prototypes.

The proceedings of the symposium are available from BHRA Fluid Engineering, Cranfield, Bedford MK43 0AJ, England. Requests for further information may be sent to BHRA or the Office of Naval Research Branch Office, London.

Dr. R.H. Bourke
LCDR R.W. Booker

ONR London

ONR COSPONSORED CONFERENCES

General Conference on Condensed Matter, Univ. of Manchester, UK, 22-25 March 1982.

IXth IUPAC Symposium on Photochemistry, Univ. of Pau, France, 25-31 July 1982.

International Conference on Forward Swept Wing Aircraft, Univ. of Bristol, UK, 24-26 March 1982.

International Aerospace Conference on Lightning & Static Electricity, St. Catherine's College, Oxford, UK, 23-25 March 1982.

EUROPEAN VISITORS TO THE US SUPPORTED BY ONR LONDON

<u>Visitor</u>	<u>Affiliation</u>	<u>Navy Lab./Org. to be Visited</u>
Prof. H.A. Gebbie	Dept. of Electrical Engineering, Imperial College of Science & Technology	NRL (14 or 15 December 1981)
Prof. B. Henderson	Dept. of Pure & Applied Physics, Trinity College Dublin, Eire	NRL (10-11 December 1981)
Dr. J.A. Johnson	School of Mathematics & Physics, Univ. of East Anglia, Norwich, UK	NPGS, Monterey (12-17 December 1981) Oregon State Univ. (18-22 December 1981)

ONAL REPORTS

- C-1-81 The Second International Conference on Antennas and Propagation, by T.C. Cheston and R. Mittra
- The Second International Conference on Antennas and Propagation took place in York, England in April 1981. This report reviews some of the antenna papers.
- C-6-81 4th International Topical Conference on High-Power Electron and Ion-Beam Research and Technology, by J.R. Neighbours
- The Fourth International Topical Conference on High-Power Electron and Ion-Beam Research and Technology was held in Palaiseau, France on 29 June - 3 July 1981. The program included electron and ion beam generators, beam transport plasma heating and free electron lasers. This report is principally about foreign research results. It also contains a list of speakers and the topics discussed.
- C-10-81 Seventh Annual Congress of the European Undersea Biomedical Society and Symposium on Decompression, by Robert Goad
- The Seventh Annual Congress of the European Undersea Biomedical Society and a Symposium on Decompression Sickness (the latter sponsored by the North Sea Medical Center, Great Yarmouth, England) was held at Churchill College in Cambridge, England on July 21-24, 1981. Approximately 50 presentations covered a wide variety of topics, with an emphasis on neurological decompression sickness. There was also a session on the medical aspects of amateur diving, and the program included a visit to the British Antarctic Survey for those interested. This report contains a brief summary of each paper.

C-13-81

Fifth International Biodeterioration Symposium, Aberdeen, Scotland, 7-11 September 1981, by E.C. Haderlie

The meeting covered most aspects of biodeterioration ranging from the degradation of library materials to woods, metals, petroleum products, and wool. Biodeterioration was defined as the degradation of materials as a result of the activities of living organisms.

R-6-81

Polymer and Surface Science in Europe, Israel, and Egypt: Some Observations, by W.D. Bascom

This report contains the author's observations relating to polymer and surface science research activities in European and Middle Eastern countries with emphasis on the quality and quantity of research and the directions research efforts are taking. The information was obtained in visits to university and industrial laboratories and government research organizations over a period of 21 months.

SUBJECT INDEX FOR VOLUME 35, ESN ISSUES 1 THROUGH 12, 1981

The articles are listed chronologically under subject heading with title, author and issue page numbers. Thus, 6:211 indicates issue 6, page 211 of volume 35.

AEROSPACE

- | | | |
|--|-------|-------------|
| Acrodynamic Research at British Aerospace
Dynamics Group, Bristol | 2:51 | J.A. Strada |
| Aeronautical Engineering at Israel's
Technion | 6:211 | J.A. Strada |

AUTOMATION

- | | | |
|-----------------------------------|------|----------------------------------|
| How Computers Can Help Physicians | 2:52 | R.E. Machol &
M.A. Greenfield |
|-----------------------------------|------|----------------------------------|

BEHAVIORAL SCIENCES

- | | | |
|--|--------|----------------|
| Human-Computer Mismatch | 7:247 | N.A. Bond, Jr. |
| Physiological Prediction of Marginal
Behavior? | 7:249 | N.A. Bond, Jr. |
| Shift Work and Efficiency | 7:250 | N.A. Bond, Jr. |
| Bomb-Disposal Operators: What's so
Special About Them? | 8:287 | N.A. Bond, Jr. |
| Ionized Air and VDU Operators | 8:289 | N.A. Bond, Jr. |
| Substitutes for IQ Scores | 8:290 | N.A. Bond, Jr. |
| Human Sciences at Loughborough | 9:327 | N.A. Bond, Jr. |
| System Control Behavior at Oxford
University | 9:330 | N.A. Bond, Jr. |
| Auditory Warnings in Aircraft:
Loudness and Memory Research at
Cambridge | 10:369 | N.A. Bond, Jr. |
| Artificial and Human Intelligence | 11:407 | N.A. Bond, Jr. |
| Organizational Change in Merchant
Shipping | 11:410 | N.A. Bond, Jr. |
| Blood Lead Concentration and Performance | 12:439 | N.A. Bond, Jr. |
| Task Complexity and Team Organization | 12:440 | N.A. Bond, Jr. |
| Tabacco Use: Smokers, Snuffers, and Stoppers | 12:441 | N.A. Bond, Jr. |

BIOLOGICAL SCIENCES

- | | | |
|--|--------|----------------|
| Bioelectrochemistry and Bioenergetics VI | 9:331 | M. Blank |
| Surface and Colloid Science | 9:335 | M. Blank |
| Transcutaneous Pain Reduction: Two
Italian Studies | 10:370 | N.A. Bond, Jr. |
| Unit of Blood Pressure: Protecting
the Millimeter of Mercury | 11:413 | J.C. Rose |
| International Symposium on Recent Advances
in Enteric Infections, Bruges, Belgium,
8-11 September 1981 | 12:443 | J.C. Coolbaugh |

CHEMISTRY

- | | | |
|---|------|-------------|
| Ion Formation from Organic Solids | 1:1 | R.J. Colton |
| Liquid Crystal Polymers Symposium | 1:4 | R.W. Lenz |
| International Dynamic Mass Spectrometry
Conference, 1980 | 2:57 | J.R. Wyatt |
| Photochemistry at the City University,
London | 2:58 | A.P. Schaap |
| Second International Symposium on
Homogeneous Catalysis | 2:60 | T. Katz |

Chemical Research at the Institut für Strahlenchemie, Mülheim	3:101	A.P. Schaap
Photooxygenation Research in Strasbourg	3:104	A.P. Schaap
Photochemical Research at the Royal Institution	4:146	A.P. Schaap
The Faraday Discussion No. 70: Photoelectrochemistry	6:213	J.J. Smith
Photocatalyzed Water-Splitting at the Institute for Organic Chemistry TNO, Utrecht	6:215	A.P. Schaap
Picosecond Luminescence Experiments at the University of Berne	7:252	A.P. Schaap
Experiments with Optically Active Polymers in Utrecht	8:292	A.P. Schaap
International Seminar on the Activation of CO ₂ and Heteroallenes on Metal Centers	8:293	K.J. Wynne
Photochemistry and High Pressure Studies at the University of Frankfurt	8:295	A.P. Schaap
Organic Chemistry at the University of Munich	10:372	A.P. Schaap
3rd International Symposium on Inorganic Ring Systems	11:415	C.W. Allen
6th International Symposium on Organo-Silicon Chemistry	11:416	C.W. Allen
32nd Meeting of the International Society of Electrochemistry in Dubrovnik/Cavtat, Yugoslavia: 13-20 September 1981	12:445	E. Yeager

COMMUNICATIONS

The UK National Physical Laboratory: It Pays to Advertise	3:105	P. Fire
---	-------	---------

COMMUNICATION SCIENCES

Communications R&D at Sweden's Technical High School—Part III	1:5	P. Fire
Two Interviews in Cairo Concerning Science and Telecommunications	1:10	T.C. Cheston
A New Max-Planck-Institute	9:337	P. Fire
Two Dutch Institutes for Perception Studies	9:338	P. Fire
The Grandes Ecoles of Telecommunications	10:375	P. Fire
ECOC In Copenhagen	11:417	G.W. Day
Some Communications R&D in Eindhoven	11:419	P. Fire
Laboratoire D'Informatique Pour La Mecanique Et Les Sciences De L'Ingenieur (LIMSI), France	12:447	P. Fire

COMPUTER SCIENCES

Computer Systems Laboratory, Queen Mary College, University of London (UK)	2:61	Y.S. Wu
EMMA (Italy)	3:107	Y.S. Wu
Computer Graphics at the University of Geneva	5:179	R.E. Machol
Distributed Multi-Microprocessor Prototype in Pisa	6:219	Y.S. Wu
KARL—A Hardware Design Language from the University of Kaiserslautern	6:220	Y.S. Wu
UK's Ministry of Defense Computer Standardization Policy—A Comparison	7:254	Y.S. Wu
Distributed Computing Systems (DCS) Research Program in the UK	8:298	Y.S. Wu

International Conference on Very Large Scale Integration (VLSI81) in Edinburgh	10:378	R. Grafton
Signal Processing at Société Industrielle Des Nouvelles Techniques Radioélectrique (SINTRA)—France	10:380	Y.S. Wu
Research in Signal Processing at Imperial College of Science and Technology (UK)	11:421	Y.S. Wu
Centralized Government Management Information System in Israel	12:449	Y.S. Wu
The IBM Israel Scientific Center: An Ultrasonic Signal Processing Facility	12:451	Y.S. Wu
<u>EARTH SCIENCES</u>		
Meteorology and Climatology in Greek Universities	1:11	W.V. Burt
Geotechnology at the University of Perpignan, France	11:423	W.V. Burt
Lightning Research in the Ivory Coast, Italy, and France	12:453	E.P. Krider
<u>EDUCATION</u>		
Academic Titles and Degrees at Italian Universities: What's in a Title?— Revisited	3:110	P. Fire
The Science of Action	4:149	R.E. Machol
<u>ENERGY</u>		
Solar Energy in Israel	4:152	T.C. Cheston & W.V. Burt
Future Energy Concepts	5:181	J.R. Neighbours
The Twelfth International Power Sources Symposium	5:184	J.J. Smith
<u>ENGINEERING</u>		
Anechoic Chamber Par Excellence; Remote Sensing and Other Goodies from Denmark	1:12	T.C. Cheston
UK EISCAT Users School at the University of Leicester	1:14	D.T. Newell
Antennas and Related Topics from Siemens A.G. and A.E.G. Telefunken	2:63	T.C. Cheston
Military Microwaves '80 Conference in London	2:66	T.C. Cheston
From Antennas to Acoustic Microscopes at London's University College	3:111	T.C. Cheston
Sonar & Signal Processing at Loughborough	3:114	T.C. Cheston
Data Acquisition and Analysis Can Be Very Profitable—Service Technique Schlumberger, Paris	4:154	Y.S. Wu
Ocean Bottom and Related Investigations at the University of Bath	4:157	T.C. Cheston
The Istituto di Elettrotecnica of the University of Genoa	4:158	P. Fire
Microwave Measurements in Lausanne	5:189	T.C. Cheston
Remote Sensing and Precision Measurements in Berne	5:191	T.C. Cheston
Antennas from Turin	6:221	T.C. Cheston
Components for 80-300 GHz—A Colloquium	6:223	T.C. Cheston
Microwave Research in Toulouse	7:257	T.C. Cheston
University of Tel Aviv and the Technion: From Seismics to Optics	7:259	T.C. Cheston

HF Radar Remote Sensing and Other Radiating Systems Research at the University of Birmingham	8:301	T.C. Cheston
The Radiation Laboratory of the University of Naples	8:303	T.C. Cheston
Some Electrical Engineering R&D at the Technion, Israel	8:304	P. Fire
Antennas and Other Things from Rome's Selenia and Elettronica	9:343	T.C. Cheston
Antenna and Microwave Research at the Middle East Technical University	10:381	T.C. Cheston
Société Internationale de Telecommunications Aeronautiques (SITA)—A Profitable Nonprofit Organization	10:382	Y.S. Wu
The Universities of Ljubljana and Belgrade: Research in Electrical Engineering	10:385	T.C. Cheston

ENVIRONMENTAL SCIENCES

Symposium on Current Problems of Weather Prediction, Vienna, Austria	9:345	R. Elsberry
Natural and Manmade Aerosols—The Particles in the Air Can Fool You	10:387	B. Baier

MATERIAL SCIENCES

Composites III	1:15	W.D. Bascom
Polymer Technology in Manchester	1:17	W.D. Bascom
Composites IV	2:68	W.D. Bascom
Polymer Science in Italy	2:70	W.D. Bascom
A Visit to the Institute for Radiation Hygiene of the Federal Health Office in Munich	2:74	M.A. Greenfield
DKI—Deutsches Kunststoff Institut	3:116	W.D. Bascom
Polymer Science in Southern Germany	6:225	W.D. Bascom
Surface and Polymer Science at Mulhouse	6:228	W.D. Bascom
European R&D in Biomaterials	7:261	R. Baier
Polymer Science at BASF	7:263	W.D. Bascom
Composites V	8:307	W.D. Bascom
Rapid Solidification Research in Switzerland, France and West Germany	8:312	D.E. Polk
Ion Implantation at the UK Atomic Energy Research Establishment	8:347	P. Clarkin
Interfacial Science at the University of Surrey	10:388	P.A. Clarkin
2nd European Conference on Non-Destructive Testing	10:391	P.A. Clarkin
NATO Advanced Research Institute on Surface Modification and Alloying of Materials by Direct Energy Processing	11:424	D. Turnbull
Some R&D Activities at British Aluminium Company Ltd.	11:425	P.A. Clarkin
Stress Corrosion at Alcan International LTD., Banbury, England	11:427	P.A. Clarkin
UMIST Conference on Ion Implantation	11:429	W.A. Grant
Metallurgical Research at the Royal Aircraft Establishment	12:455	P.A. Clarkin
Some Processing Research at Imperial College	12:457	P.A. Clarkin

MATHEMATICS

Fourth Oberwolfach Conference on Scattering Theory: Scattering Problems of Classical and Applied Physics	7:265	J.A. DeSanto, A.W. Saenz & W.W. Zachary
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MEDICAL PHYSICS

Current Levels of Gonadal Irradiation from X-ray Examination in Great Britain	1:21	M.A. Greenfield
Genetically Significant Dose from Diagnostic Radiology in Great Britain in 1977	1:23	M.A. Greenfield
Biophysics of Water: A Working Conference	9:349	P. Beall

MEDICAL SCIENCES

The British Physiological Society Meeting	1:26	P.T. Beall
The XXVIII International Congress of Physiological Sciences	1:27	P.T. Beall
The Public Health Laboratory Service International Workshop on Campylobacter Infections	5:192	B. Merrell

METEOROLOGY

Climate Research at the University of East Anglia	4:161	W.V. Burt
Environmental Research in Saudi Arabia	4:163	L.H. Ruhnke

OCEAN SCIENCES

The Marine Biology Laboratory at Elat, Israel	1:28	W.V. Burt
Marine Environmental Research in Plymouth	1:30	W.V. Burt
The Israel Oceanographic and Limnological Research Ltd.	2:77	W.V. Burt
The Lake Kinneret Limnological Laboratory, Israel	2:81	W.V. Burt
The Marine Biology Group at the University of Tel Aviv	2:83	W.V. Burt
A Fish Story from Iceland	3:118	W.V. Burt
The Icelandic Hydrographic Office	3:119	W.V. Burt
Some Marine Research in Iceland	3:120	W.V. Burt
Station Marine d'Endoume - Marseilles	4:164	W.V. Burt
Marine Research at the Jerusalem Environmental Health Laboratory	4:165	W.V. Burt
Oceanography at Lowestoft	5:194	W.V. Burt
The Marine Geology Division of the Israel Geological Survey	6:230	W.V. Burt
The Institute for Marine Sciences at the University of Kiel, FRG	7:269	W.V. Burt
Marine Technology at Strathclyde University	10:395	W.V. Burt
FRAM Ice Floe Stations	11:430	L. Johnson
Marine Science at the University of Durham, England	11:431	W.V. Burt

OPERATIONS RESERACH

Operations Research and Related Activities in Morocco	1:33	R.E. Machol
Systems Approach for Development	2:85	R.E. Machol
Fuzzy Sets	3:124	R.E. Machol
Operations Research at Ciba-Geigy	3:127	R.E. Machol
Operations Research in Belgium—Part I, Some Universities	3:131	R.E. Machol
Alimentary Crisis Management in Switzerland	4:166	R.E. Machol
Operations Research in Belgium—Part II	4:168	R.E. Machol
The Operational Research Executive at the Coal Board (UK)	5:197	R.E. Machol
Operations Research at Swiss Schools—Part I, Engineering Schools	5:201	R.E. Machol

Operations Research at Swiss Schools—Part II, Universities	6:231	R.E. Machol
Operations Research in Portugal	6:235	R.E. Machol
UK Reliability Conference	8:315	M.B. Kline
IFORS IX	9:352	R. Machol
Budapest Decision Conference	10:397	B. Fischhoff

PHYSICS

Research in Transition, A Visit to Daresbury Laboratory	1:36	J.R. Neighbours
Some Solid State Physics in the Netherlands II—Nijmegen	1:39	J.R. Neighbours
Fourteenth European Conference on Laser Interaction with Matter	2:88	E.A. McLean
Some Finnish Fysics	2:90	J.R. Neighbours
Ultrasonic Research at Hull	2:93	J.R. Neighbours
Annual UK Solid State Physics Conference	3:134	J.R. Neighbours
Some Solid State Physics at Sunderland Polytechnic (UK)	3:137	J.R. Neighbours
XUV Gain at Hull	3:138	W.J. Condell
Some Solid State Physics in Denmark	4:172	J.R. Neighbours
Landing in Lund—Some Physics in Sweden	4:174	J.R. Neighbours
International Conference on Excited States and Multiresonant Nonlinear Optical Processes in Solids	5:205	M. Dagenais & H. Winful
Ultrasonics at the University of Bath	5:207	J.R. Neighbours
A Visit to Israel - Part I - Bar Ilan University	6:238	J.R. Neighbours
Some Research in Exeter	6:240	J.R. Neighbours
A Visit to the University College of North Wales, Bangor	7:273	J.R. Neighbours
Fourth International Conference on Electrostatics	7:275	J.T. Leonard
Metal Organic Vapor Phase Exptaxy Conference Report	7:276	J.W. Bailey
A Visit to Israel - Part II - Tel Aviv University	7:279	J.R. Neighbours
The Fraunhofer Institute for Applied Solid State Physics	7:281	A.E. Mardiguian
Polywater and Birkbeck College: An Epilogue	8:316	W.D. Bascom
From Cryogenics to Quarks in Genoa	8:317	J.R. Neighbours
A Visit to Israel III - The Technion	8:319	J.R. Neighbours
Amorphous and Liquid Semiconductor Conference	9:355	T. Donovan
Radiations at Frascati	9:356	J.R. Neighbours
A Visit to Israel IV—Hebrew University	9:359	J.R. Neighbours
First European Conference on Integrated Optics	10:398	J.R. Neighbours
UK Physical Acoustics Meeting	10:401	J.R. Neighbours
Physical Acoustics in Kent	11:432	J.R. Neighbours
Solid State Physics at the University of Konstanz	11:433	J.R. Neighbours
Magnet Manufacturing in Sussex	12:460	J.R. Neighbours
Solid State Physics in Stockholm	12:461	J.R. Neighbours

TECHNOLOGY

New Swedish Diving Facility	9:362	R. Goad
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